

Contents—Mar. 1945

Volume XXVI

No. 3

ARCHIVES OF PHYSICAL MEDICINE

(Formerly Archives of Physical Therapy)

30 North Michigan Avenue, Chicago 2, Illinois

Original contributions, exchanges and books for review should be forwarded to the Editorial Office. All business matters including advertising should be handled through the Executive Office, 30 N. Michigan Ave., Chicago 2, Illinois. The statements in the manuscripts published in the ARCHIVES OF PHYSICAL MEDICINE are made solely on the responsibility of the author. The American Congress of Physical Medicine does not assume any responsibility for statements contained therein. Manuscripts accepted for publication in ARCHIVES OF PHYSICAL MEDICINE are for exclusive publication and may not be published elsewhere.

OFFICERS

American Congress of Physical Medicine

MILAND E. KNAPP, M.D.,
Minneapolis, President.
WALTER S. McCLELLAN, M.D.,
Saratoga Springs, N. Y.,
President-Elect.
*H. WORLEY KENDELL, M.D.,
Brookhaven, Miss., First Vice-President.
*O. LEONARD HUDDLESTON, M.D.,
Denver, Colo., Second Vice-President.
EARL C. ELKINS, M.D.,
Rochester, Minn., Third Vice-President.
ARTHUR L. WATKINS, M.D.,
Boston, Fourth Vice-President.
ROBERT L. BENNETT, M.D.,
Warm Springs, Ga., Fifth Vice-President.
RICHARD KOVACS, M.D.,
New York, Secretary.
JOHN S. COULTER, M.D.,
Chicago, Treasurer.
WALTER J. ZEITER, M.D.,
Cleveland, Executive Director.
MARION G. SMITH, B.Sc.,
Chicago, Executive Secretary.

EXECUTIVE COUNCIL

Kristian G. Hansson, M.D., New York, *Chairman*.
*Norman E. Titus, M.D., Los Angeles, *Secretary*.
William Bierman, M.D., New York.
John S. Coulter, M.D., Chicago.
James C. Elsom, Madison, Wisconsin.
Frank H. Ewerhardt, M.D., St. Louis, Missouri.
Roy W. Fouts, M.D., Omaha, Nebraska.
John Severy Hibben, M.D., Pasadena, Calif.
Abraham E. Hollender, M.D., Chicago.
Disraeli Kobak, M.D., Chicago.
Frank H. Krusen, Rochester, Minnesota.
Fred B. Moor, M.D., Los Angeles.
Nathan H. Palmer, M.D., New Orleans.
William H. Schmidt, M.D., Philadelphia.
Frederick L. Wahrer, M.D., Marshalltown, Iowa.
Miland E. Knapp, M.D., Minneapolis, *Executive Office*.

EDITOR EMERITUS

DISRAELI KOBAK, M.D.,
Chicago.

* In Active Service.

Subscription — In the United States, its possessions, and Mexico, \$5.00 yearly; Canada, \$5.50; elsewhere, \$6.50 the year. Advertising rates on application. All advertising copy subject to acceptance by publication committee. Published monthly at Chicago, Illinois, by American Congress of Physical Medicine. Entered as Second Class Matter, February 15, 1945, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879.

ORIGINAL ARTICLES

Functions of a Center for Instruction and Research in
Physical Medicine.....George Morris Piersol, M.D. 133

Treatment of Military Amputees.....
Capt. Robert F. Dow, M.C., A. U. S. 139
Discussed by Capt. Louis Rudin.

Peripheral Vascular Reactions After Sympathectomy
.....Karl Harpuder, M.D. 149

Mineral Water Therapy: An Appraisal.....
M. B. Jarman, M.D. 153

Massage—Physiologic Basis
C. Wesler Scull, Ph.D. 159

Electric Shock Therapy of the Psychoses.....
Samuel H. Ruskin, M.D. 168

Editorials 173

Medical News 175

Book Reviews 179

Physical Medicine Abstracts..... 182

EDITOR OF THE MONTH

ARTHUR L. WATKINS, M.D.

Boston, Mass.

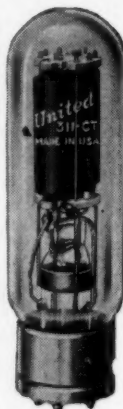
OPPORTUNITIES AVAILABLE

WANTED PHYSICAL THERAPY TECHNICIANS FOR FOLLOWING: (a) Large teaching hospital; central metropolis; \$200. (b) To take charge and develop department, 250-bed hospital; vicinity New York City. (c) Hospital for crippled children; beautifully located in the country; institution has own farm and dairies; South. (d) Privately-operated hospital of medium bed capacity; minimum, \$175; San Francisco area. (e) Rehabilitation clinic; Mid-West. (f) To joint department of physical therapy, group clinic, staffed by thirty specialists; West. (g) To join staff of visiting nurse association; Middle West metropolis; salary dependent upon qualifications but not less than \$200. (h) To direct department; 400-bed hospital; department well equipped; must be able to interest staff physicians in department; challenging opportunity; minimum, \$200. (i) to join staff of fairly large clinic operating new hospital of nearly 300-beds; growing organization; excellent opportunity for advance; salary starts at \$2700-\$3000; 48 hour week; straight time for overtime; South. For further information, please write Burneice Larson, Director, Medical Bureau, Palmolive Building, Chicago.

SITUATIONS WANTED

PHYSICAL THERAPY TECHNICIAN is available; B.S. degree with major in physical therapy; several years in charge of department, small hospital; for further information, please write

BURNEICE LARSON, Director, Medical Bureau
Palmolive Building, Chicago, Illinois



DIATHERMY TUBES by UNITED

• Available for replacements in most standard makes of machines, under provisions of War Production Board Order No. L-265.

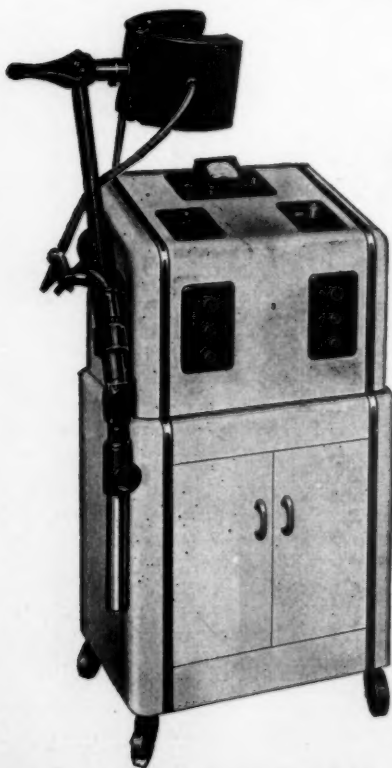
Since 1936, UNITED Tubes have been standard initial equipment in most of the leading makes of short wave diathermy machines.

Write for descriptive folder and tube replacement guide, for correct selection of type required for your machine. (There are 12 different types.)

Available at your surgical supply house or radio parts distributors.



**UNITED ELECTRONICS
COMPANY**
NEWARK 2 • NEW JERSEY



SHORT WAVE DIATHERMY

MODEL SW-221
(Illustrated)

A dependable general-purpose unit featuring the adaptable **HINGED Treatment Drum** and providing also for pad, cuff, inductance cable and orificial applications.

MODEL SW-550
(Dual Wave)

Two circuits—Short and Ultra-Short. Provides every known diathermy treatment modality and each at its best. America's finest Diathermy Unit.

THE LIEBEL-FLARSHEIM CO.

303 West Third St., Cincinnati 2, Ohio

FUNCTIONS OF A CENTER FOR INSTRUCTION AND RESEARCH IN PHYSICAL MEDICINE *

GEORGE MORRIS PIERSOL, M.D.

Director of the Center for Instruction and Research in Physical Medicine, University of Pennsylvania

PHILADELPHIA

The devastation and destruction of war so dominate the picture that one is apt to overlook the fact that even out of the suffering and carnage of a worldwide conflict some benefits accrue to mankind. The ingenuity and inventiveness of man are stimulated when he is confronted with the necessity of devising better methods of self preservation on the one hand and more effective means of destruction on the other. When the facilities that have been developed to produce the engines of war are converted to meet the needs of peace the extraordinary progress that has taken place along many lines will become apparent. Advances that will make for a more comfortable and efficient way of life will not be limited to mechanical inventions; medicine, too, will share to no small degree in the advantages that have come out of war. Would the production of penicillin have reached astronomical proportions in such an incredibly short time had not our mounting battle casualties created an acute, urgent demand? Who can doubt that the exigencies of war have advanced by many years our knowledge of surgical shock and of how to protect human beings subjected to such abnormal environments as excessive heat, cold and variations in atmospheric pressure, to mention only a few of the conspicuous advances in medicine that have been accelerated tremendously by war?

Although less conspicuous and less dramatic, another field of medical endeavor has been definitely stimulated and advanced as the result of problems arising out of war, namely, physical medicine. It would be an exaggeration to say that the present upsurge of interest in physical medicine is largely the result of war. Nevertheless, it cannot be denied that if World War I did much to direct attention to physical medicine, the present conflict, with its vast rehabilitation program rapidly developing, is destined to do more. Long before this nation became involved in the present titanic struggle, there were individuals and groups manifesting an earnest, albeit somewhat belated, interest in the development of physical medicine in this country. Although war has acted as a tremendous accelerator, even without this stimulus an appreciation of the value and importance of physical medicine was making itself felt.

To those who have given the question consideration, it has long been clear that if physical medicine is to take its rightful place among recognized medical specialties, certain steps are necessary: 1. The well known apathy of physicians as a whole toward physical medicine has to be overcome. 2. An adequate group of physicians especially trained in physical medicine has to be developed. 3. The education and training of physical therapy and occupational therapy technicians has to be improved; the interest of a much larger group of persons has to be enlisted in this work. 4. The principles and technics employed in physical medicine need to be established on a firm foundation of scientific facts.

* Read before the Twenty-Third Annual Session of the American Congress of Physical Medicine, Cleveland, Sept. 8, 1944.

The necessity for such a program has been emphasized by the urgent demand of our armed forces for physicians skilled in physical medicine, who, for the most part, were nonexistent, and for a number of well trained physical and occupational therapy technicians that far exceeded any possible supply. As a solution of these difficulties the idea of establishing centers designed to further instruction and research in physical medicine was advanced.

A year ago, those charged with the conduct of graduate medical education at the University of Pennsylvania showed vision and imagination when they evolved a plan for the development of such a center at that institution. This conception, designed to further teaching and investigation in physical medicine, was received with such interest by Mr. Basil O'Connor and those associated with him in the National Foundation for Infantile Paralysis that it was given generous support in the shape of a substantial grant for a five year period. Thanks to this far sighted generosity, there is now in operation at the University of Pennsylvania a center for physical medicine planned to carry out a long range, comprehensive program of teaching and research. The most complete discussion of the aims and possibilities of a center of this kind is to be found in the well considered and thoughtfully prepared report of the Baruch Committee on Physical Medicine. It is with no small satisfaction that those who are responsible for the undertaking at the University of Pennsylvania have noted that the plan independently proposed by them is fundamentally in agreement with the suggestions found in the Baruch Committee's report.

It is generally agreed that if a center for physical medicine is to operate efficiently and economically the place of its establishment must fulfill certain conditions: 1. It must provide general hospitals supplying adequate clinical material. In such hospitals there should be in operation thoroughly equipped departments of physical therapy able to function as the laboratories for practical training in the technics employed in physical medicine. 2. It should offer already established and well organized facilities for the teaching of medicine, particularly graduate teaching. 3. There should be available competent departments devoted to the basic sciences. Such departments should be prepared not only to give instruction in these subjects but also to cooperate with the department of physical medicine in conducting investigations of a fundamental character.

Such a combination of clinical, teaching, and investigative facilities is rarely found except within the walls of our universities. These criteria seem to have been kept in mind in the selection of locations for the centers of physical medicine that have recently been established.

At this time a discussion of the functions of a center for physical medicine must of necessity be somewhat theoretical, since the concept is new and to date there has been neither time nor opportunity to observe such an organization in full operation. The pioneer work, both educational and experimental, that for a number of years has been so successfully carried on by the departments of physical medicine at Northwestern University, the Mayo Clinic, Columbia University and doubtless elsewhere furnishes valuable examples to be followed by those who are charged with the development of new centers for physical medicine.

Heretofore the chief criticism directed against physical medicine has been that many of the methods employed have been based on empiricism more than on established scientific fact. This has militated against whole-hearted acceptance of physical medicine by the medical profession in general. Undoubtedly much valuable experimental data has been accumulated in connection with the basic sciences that underlie various aspects of the subject. Many of these observations remain isolated and need to be correlated with the

problems of physical medicine. Useful and suggestive clinical studies have been reported, but too often they have not been checked by adequate controls and conclusions have been drawn from subjective rather than from objective evidence. It would seem, therefore, that the first and most important function of a center devoted to physical medicine should be to devise ways of scientifically evaluating the technics employed in physical medicine and of appraising their clinical value. Until this has been done it will be difficult to draw accurate conclusions as to the effectiveness of the numerous technics that are now employed. To undertake such clinical evaluation obviously involves complicated research problems which will require the co-ordinated efforts of trained experimentalists and open-minded clinicians and will tax the ingenuity and imagination of both. If the various questions that present themselves could be solved by animal experimentation alone, their solution would present less difficulty. Since the object of all therapy is to bring relief to patients and if possible cure the underlying condition, it is obvious that in the last analysis research in physical medicine must be carried out on human beings. This has been well emphasized by others. Since all persons react differently and since no two cases of any given condition are identical it is admittedly hard to set up human experiments that are properly controlled. To this difficulty must be added the all important psychic factor, which is ever present and looms large in human experimentation.

Although research of a basic as well as of a clinical nature must be one of the chief concerns of centers for physical medicine, it should not be restricted to the study of existing methods. Constant effort should be made to improve on present technics, to devise new and more effective apparatus and, above all, to develop original and more satisfactory methods of treatment.

Investigation in its broadest sense may rightfully be regarded as the most important and at the same time the most difficult function of a center for physical medicine. The next most essential function is the organization and direction of teaching. Comprehensive, systematic instruction in physical medicine is essentially a graduate rather than an undergraduate activity, although the undergraduate aspects should not be neglected. Whenever possible, a center should be established as part of or in conjunction with a graduate school of medicine. With the facilities of such a school available, there can be organized a well rounded course in physical medicine comparable to the graduate courses given in the other recognized specialties of medicine and surgery. The first part of such a course should consist of a basic year in which the student physicians are given an adequate review of the fundamental medical sciences, particularly those that are intimately concerned with the problems of physical medicine. Coincidentally they should be given not only a thorough training in the recognized methods and technics of physical therapy, but also an opportunity to observe and study clinical material, particularly in those departments which call on physical medicine most often in the management of their patients. In such a course it is not enough to have the instruction didactic and theoretical. The students should be given ample opportunity to handle patients personally, to observe the effects of physical procedures on different conditions and, above all, to acquire by actual practice individual skill and dexterity in carrying out the technics of physical medicine. At the successful conclusion of such a basic year, those who are seriously intent on becoming qualified specialists in physical medicine should continue their studies for one or more additional years with a view of obtaining such a degree as master or doctor of medical sciences in physical medicine. During these additional years the student's interest should be directed to special work, largely of an investiga-

tive character. The course will be made more attractive to physicians by the establishment of fellowships in physical medicine. Such opportunities already exist in some institutions and plans are underway to make available many more. For a number of years fellowships have been in operation at the Mayo Clinic, where a plan has been adopted that might well be followed elsewhere. Fellows in physical medicine, instead of devoting their entire time to that department, spend uninterruptedly several months out of each year in the divisions of the clinic that are most closely affiliated with physical medicine, for example the departments that concentrate on arthritis, peripheral vascular disease and orthopedic surgery. A reciprocal arrangement exists by which fellows in these departments devote a specified number of months to working in the department of physical medicine. Such a plan not only gives the student in physical medicine a firsthand opportunity to learn and understand the clinical problems of those who most often employ physical therapy, but also tends to break down such artificial barriers as may exist between departments by creating a better spirit of cooperation and mutual understanding. When an adequate training program for physicians has been developed and a more widespread interest in physical medicine has been aroused among the younger physicians of this country, a group of men well versed in scientific physical medicine will for the first time be available to go forth to establish and conduct departments in this field and to carry on a broad and expanding educational program throughout the land.

The instruction of undergraduate medical students in physical medicine presents a different problem. It is regrettable that in the past physical medicine has been largely neglected and often ignored in our medical schools. As a result of increasing interest in the subject, this situation is being corrected. At the best, however, our graduates enter on their internships and later the practice of medicine knowing little about even the fundamentals of physical medicine. The conduct of undergraduate teaching in this subject is properly one of the functions of a center. In arranging the teaching of undergraduates, a proper perspective must be maintained; the already overcrowded state of the curriculum must be taken into consideration and the present status of physical medicine in relation to other forms of therapeutics must be kept in mind. To the overenthusiastic, who believe that a comprehensive course in physical therapy should be introduced into undergraduate curriculums, a word of warning should be sounded. No one will deny that physical medicine offers a valuable field of therapeutics and a useful adjunct in the management of many diseases. Nevertheless, when centers are being established for the prime object of studying and evaluating the technics of physical medicine, it must be admitted that the subject scarcely rests on as well recognized a foundation as such branches of therapeutics as pharmacology and radiology. Until such time as our knowledge of physical medicine is more crystallized, it would seem premature to overemphasize the subject in our undergraduate courses. Adequate instruction is obviously desirable, and a reasonable number of hours should be allotted to the subject in the third or fourth year of the medical course. In view of the present status of physical medicine it would seem appropriate to stress to undergraduates what is known of the fundamental physiologic and physical principles underlying physical therapy; to point out to them what therapeutic results may reasonably be expected from physical methods of treatment, carefully avoiding exaggerated claims and unproved dogmatic statements. The course should be as practical as time and facilities permit, liberally illustrated by demonstrations of apparatus and the actual carrying out of vari-

ous technics. Our educational efforts should be directed toward making our medical students conscious of the value of physical methods of treatment in properly selected cases and of the vast but unexplored potentialities offered by this form of therapy. In addition to a prescribed course, undergraduates in their last year should be given a chance to take up physical medicine as an elective, just as is done with the other specialties.

In order to arouse in students early in their medical careers an awareness of the importance and sound physiologic background on which many forms of physical treatment are based, a plan which is so successfully carried out at Northwestern Medical School is worthy of extended trial. In that institution there has been developed an unusual degree of cooperation between the basic science departments, notably that of physiology, and the department of physical medicine. The result is that the teaching of abstract scientific subjects is leavened by stressing at the appropriate place in the course the relationship which they bear to the practical application of physical forms of treatment.

The education of the medical student in physical medicine should not cease with graduation. It should be continued during the period of internship. In hospitals where departments of physical medicine are in operation, the intern schedule should provide for a certain amount of time to be devoted to that department, as is already done for roentgenology, anesthesia, clinical pathology and the other laboratory departments. Those who are in charge of the various clinical services in our hospitals, if they are sufficiently impressed with the value of physical therapy, can further the education of interns by encouraging them to utilize the department of physical medicine freely and learn how and when to prescribe physical forms of treatment. Such a program will in time tend to develop in our clinicians of the future a more sympathetic understanding of and constructive interest in this line of medical activity.

The educational activities of a center for physical medicine are not limited to the training of physicians. They must include the development and conduct of courses for lay technicians in physical therapy. The demands created by this war have made it obvious that henceforth a large number of properly qualified, registered technicians must be available. The frantic efforts to satisfy the present urgent needs of our armed forces for physical therapy technicians will not occur again if a sufficient number of qualified schools are developed and if the opportunities for those who take up this work are made worth while. The question as to what constitutes a properly balanced course for technicians and how strict the entrance requirements for such a course should be are under discussion by those best qualified to arrive at wise conclusions. In the solution of these problems, persons concerned with the development of physical medicine should show a lively interest.

There is a definite relationship between physical medicine and occupational therapy which has been emphasized by Dr. Krusen in his latest definition of physical medicine. In the light of this concept, occupational therapy must be made the active concern of centers for physical medicine. Physical therapy and occupational therapy, both in teaching and in practice, are interrelated and interdependent. In passing it may be added that into both of these subjects there should be introduced the proper understanding of psychotherapy as well as of social service. It is not unreasonable to suggest that, in keeping with the best contemporary thought, those who are charged with the conduct of centers for physical medicine should have under their immediate supervision the schools and departments of occupational therapy.

Of less academic interest but of greater practical and economic importance to hospital management is another function of a center for physical medicine, namely, that of effectively conducting a department devoted to this type of work. The size, equipment and personnel of such a department will vary greatly according to the location, type and function of the hospital which it serves. It is axiomatic that such a department should be suitably and adequately housed, that it should be removed from the dingy, ill ventilated basement quarters to which most departments of physical medicine heretofore have been relegated. Its equipment should be up to date and adequate, not necessarily elaborate. Indeed, it is desirable to eliminate obsolete apparatus, no matter how impressive it may appear, and to concentrate on those forms of treatment of which the usefulness and safety have been proved. Efficient, well trained personnel transcends in importance complicated mechanical devices. The chief aim of such a department should be to develop along sound, scientific, clinical lines. Too often in the past a department of physical medicine has been looked on as the unwelcome stepchild of the hospital family. This attitude will change when the department makes its usefulness so apparent that the clinical divisions of the hospital look on it as an indispensable adjunct in diagnosis and the management of patients, as operating rooms, x-ray departments and clinical laboratories are now regarded. To bring about this change in attitude, the heads of departments of physical medicine must exhibit no inferiority complex. They must insist on wholehearted cooperation from their clinical colleagues. A complete clinical record should accompany patients sent to the department whether they come from the outpatient clinics or the wards. A request for physical therapy should clearly state the diagnosis and the reason for which the patient is referred to the department. Vague requests, which are all too common, wherein a patient whose condition has not been diagnosed is referred for "physical therapy" or for what in the minds of some is synonymous, "heat and massage," should be discouraged. Responsibility for the type of physical treatment to be instituted should be left entirely to the judgment of the physician who directs the department. Independently of what has been done previously, every patient who is referred to a department of physical medicine should be given a careful physical examination by a competent member of that department. The department should make its own appraisal of the condition and what should be done. A complete and careful record of the examination and the subsequent treatments should be kept. Whenever possible some form of consultation with the referring physician should be encouraged. If the request for treatment seems inappropriate, the matter should promptly be discussed with a responsible member of the referring service, in accordance with principle accepted for other forms of consultation. Thus will misunderstandings be avoided. Each department will develop an awareness of the problem of the other and there will grow up between the department of physical medicine and the clinical groups a spirit of closer cooperation and mutual confidence. This desirable relationship will be fostered if members of the staff of the department of physical medicine will arrange to make rounds and attend conferences with their colleagues in those clinical groups which most utilize the facilities of physical medicine.

The present understanding of a center for physical medicine leads to the conclusions that its chief functions are: First, to foster research designed to evaluate existing technics, to throw light on the physiological, physical and chemical mechanisms that underlie them and to devise new procedures. Second, to develop a broad educational program for physical medicine which will embrace undergraduate and graduate medical teaching, stress-

ing the latter, as well as allied activities connected with the training of physical and occupational therapy technicians. Third, the improvement of physical medicine in hospitals so that it will be regarded as a useful and necessary adjunct to the practice of medicine and surgery.

To create centers that will function usefully in the manner outlined presents many difficulties and requires time for its accomplishment. The concept is new. The course to be followed is for the most part uncharted. The proper methods to be employed in solving the many problems which present themselves have yet to be perfected. The ambitious program confidently undertaken is, in effect, a huge and novel experiment in research and education in biophysics. To bring it to fruition will require determination, resourcefulness and vision. It is to be hoped that those whose enthusiastic altruism have made possible the establishment of centers for physical medicine will appreciate the magnitude and complexities of the undertaking and not view its progress with too much impatience.

TREATMENT OF MILITARY AMPUTEES *

CAPTAIN ROBERT F. DOW

Medical Corps, Army of the United States

The treatment of military amputees differs little in its indications from that of civilians similarly handicapped. It is possible in military medicine to arrange for the treatment of these patients in so-called amputation centers, in which are situated all of the facilities necessary for their full care; this centralization offers advantages to groups of patients which are often not available to the individual patient in an isolated hospital. Most of the amputations have been necessary because of trauma, while in civilian practice the chief etiologic agents are chronic diseases, infections and local vascular insufficiency. Another feature distinguishing the military amputees has been his relative youth as compared to the age of his civilian counterpart.

Aside from the more tangible challenges of surgical care, postsurgical care, and reeducation in prosthetic use, the patient who has been deprived of one of his limbs presents a problem in psychologic and economic adjustment. The status of this problem will be influenced primarily by the degree of skill in the use of the prosthesis which may be imparted to the patient by the combined efforts of the surgeon, the limb fitter and the practitioner of physical medicine. There are modifying factors, such as the patient's age, intelligence, aptitude and state of general health, and the cause of the loss of the limb, which must be considered in the individual case and which may condition the success of the entire therapy.

A detailed treatment of the surgical considerations involved or of the technic of limb fitting is not within the scope of this paper. These subjects will be discussed only as they affect the success of the ultimate aim of the application of physical measures—namely, the efficient use of the prosthesis. The psychologic aspects assume greater importance in the amputations of

* From the Percy Jones General and Convalescent Hospital.

* Read before the Twenty-Third Annual Session of the American Congress of Physical Medicine, Cleveland, Sept. 8, 1944.

an upper extremity than in those of a lower. They are favorably influenced when their care is pursued in an atmosphere of professional competence; they are likewise affected by the mere fact of the patient's consorting with others who are about to "graduate from the course," by the amount of personal interest exhibited in his handicap by those with whom he comes in contact and, finally, by the promise of a return to the normal civic and economic life of the patient's community. The hardy veteran, with whom this paper is concerned, is a healthy, normal man who has an aversion for misplaced sympathy, for reliance on economic aid from the community and for misguided neighbors who may shun him because he wears a mechanical device in an attempt to minimize his handicap. He wants no sympathy; he wants a job and his normal place in his community; he hopes his neighbors will greet him by grasping his prosthetic hand as if it were his own. One of the most talented and admirable men I have ever known is a veteran of the last war who wears two forearm prostheses. He offers you a cigaret for the first time; you are startled, but you awaken ashamedly when he says gently, "It's all right; I washed my hands a few minutes ago." This same man cares for himself completely and efficiently; he plays a highly competitive game of billiards, drives a standard automobile, competently fills a responsible position from which he derives a good income and can pluck a cigaret from a full pack more expertly than you or I. Whether any amputee will overcome his handicap so satisfactorily will depend on his professional care, his persistence in training and the attitude of his neighbors.

The majority of military amputations fall into the first of the etiologic categories ("accidental") so practically delineated in the "Handbook on Amputations."¹ When a combat or other injury is sustained which indicates the necessity for amputation, "primary amputation should be performed at the lowest possible level which permits removal of all devitalized and contaminated tissue, regardless of stump length. Revision of the stump in accordance with prosthetic considerations may be performed subsequently."²

Directives further state, "The guillotine or open circular method of amputation is the procedure of choice in traumatic surgery under war conditions, and is especially indicated in gunshot wounds and in controlling infection." Primary suture is not performed. "The flap type OPEN operation may be done only in cases in which early evacuation is not contemplated, and subsequent closure at the same station is deemed possible."

It is directed that the patient be transferred to a general hospital designated as an amputation center. Here reamputation or revision of the stump may be performed and the amputee fitted with a temporary prosthesis and taught its use before his hospitalization is terminated. Later, he may report to a veterans' facility for fitting of a permanent type prosthesis. It is considered most important that such men perform their first clumsy attempts in most business, social and home pursuits in the relatively favorable atmosphere of the hospital, where their fellow amputees are undergoing the same training. The man who attempts something for the first time in the presence of his family or his friends may perform the act clumsily and become so embarrassed that he is discouraged from future use of the prosthesis.

The orthopedic staff in the hospital amputation center studies the patient's surgical needs on admission and measures him for his prosthesis, which is ordered immediately. If needed, further surgical care or plastic

1. Council on Physical Therapy, A. M. A.: "Handbook on Amputations," 1942, p. 12.

2. Office of the Surgeon General, U. S. Army: Circular Letter No. 91, 26 April 1943.

revision is undertaken. Fourteen to sixteen days after his surgical needs are terminated by satisfactory healing or plastic operation, he is referred to the physical medicine section.

Physical Therapy

A. *Leg Amputees*. — The unaffected foot may receive hydromassage and "flatfoot" type of exercise. The stump receives the following care:

I. Pre-Plastic-Revision Regimen:

(a) *Massage*: daily as required by training and the condition of the stump. It is to be administered in the direction of the venous flow; it is not necessary to pay special attention to the suture line; any pathologic effects there will be rectified by operation.

(b) *General body exercise and specific exercises* for the affected extremity, and the musculature proximal to it, should be carried out in order to offset the effects of inactivity already present or likely to occur in the immediate postoperative period. The object in pre-plastic-revision care is to provide as much mobilization of tissues and as good a circulation as possible. No attempt is made to toughen the skin during this period.

II. Post-Plastic-Revision Care of the Stump:

(a) *Massage*: The British do not utilize massage; Kelham³ has stated that it is harmful to the stump, although this is not the experience of many others. However, there appears to be a tendency to restrict its routine use to the preprosthetic period unless there is a specific indication for continuing it after the prosthesis arrives. The British use a different type of prosthesis and require a different type of stump for it. Massage may be administered once or more daily, according to the condition of the stump and the hazards of new training with the prosthesis. In the early stages, the massage should avoid the suture line⁴ and should be light, so as to avoid tension on the healing scar, and the physical therapist should watch for excitation of latent infection. Later, and as rapidly as the condition of the stump will permit, massage should become deeper and stronger; special attention should be given to loosening adherent suture lines from underlying tissues, to the removal of edema, to the shrinkage of subcutaneous fat and to the increase in muscle tone. Alcohol is used profusely during the massage in an attempt to dry and toughen the skin. Tapotement is used to eliminate tenderness. This consists of gentle tapping at first, progressing in the preprosthetic period to the point where firm tapping may be used forcibly without eliciting pain.

(b) *Preprosthetic Weight Bearing*: As soon as the suture line is adequately healed and tapotement has progressed to moderate severity, weight bearing by the stump on a soft object is begun; usually several layers of toweling make a satisfactory base for this weight bearing. This prepares the patient for the end-bearing prosthesis; however, even in those instances in which a weight-bearing prosthesis is not contemplated, both tapotement and practice weight bearing are utilized to render the stump free of tenderness.

(c) *Therapeutic Exercise*: In the early postoperative days, the surgeon may prescribe passive exercises to maintain the mobility of proximal joints and to counteract the tendency to contractures arising from the practice of elevating the stump on a pillow to ease discomfort.

3. Kelham, R. Langdale: "Address to Annual Congress of C. S. S. M. G.," Limb Fitting Centre, Queen Mary's Hospital, London, 24 Sept. 1943.

4. Kirk, N. T.: "Lewis' Surgery" ("Amputations"): vol. III, chap. 10, p. 116-122.

When the stump is well healed and the patient has been referred to the physical therapy clinic (usually on the fourteenth to sixteenth postoperative day in the uncomplicated case), resistive exercises, usually with adapted pulleys, are intensively carried out.

(d) General body exercises with special attention to the development of the gluteus maximus muscle and the adductors of both the affected and the unaffected side are important. The musculature of the back, abdomen and all areas proximal to the stump must be strengthened.

(e) Bandaging: Bandaging is used for the application of uniform pressure in an attempt to provide a conical stump which will conform to the needs of the prosthesis. Several elastic bandages, usually of fairly good width, are required. In the case of a thigh stump, it is desirable to apply an anchoring bandage around the pelvis. Such applications to lower extremity stumps require frequent reapplication during the day in order to maintain the pressure and counteract the natural tendency to slipping and relaxation.

III. Postprosthetic Care:

(a) The Army's Prosthesis: This has been constructed of pressed fiber and varies somewhat in its construction according to the length of the stump. All thigh prostheses have knee and ankle action which is surprisingly natural. For some thigh amputations, an artificial hip joint is rather satisfactorily incorporated. The amount of skill acquired in the use of the prosthesis depends primarily on satisfactory bone length. In general, the longer the stump, the more satisfactory the prosthetic use. The patient is measured for his prosthesis as to length of its members, size of foot, etc., before operation. The orthopedic shop orders the prosthesis on the basis of these measurements. Then, when molding of the stump has progressed sufficiently in the post-plastic-revision (preprosthetic) period, a plaster mold is taken and adjustment of the prosthesis undertaken. As soon as this is completed (usually six weeks or less after operation), if the condition of the stump is satisfactory, the patient begins to wear the prosthesis. Much of his preprosthetic care is continued while he is in the novice prosthetic class, and, in addition, he must perform walking reeducational exercises under the direct supervision of a physical therapist.

As the patient progresses, he arrives at a point where his walking may be supervised by a physical training sergeant during a portion of the day, but he still receives some professional guidance from the physical therapist; practice weight bearing by the stump is discontinued once the prosthesis begins to be used adequately.

(b) If massage has been employed, it may be discontinued during the postprosthetic period in some cases. In others, it must be continued in order to mobilize further an adherent scar. In some instances, too, it must be continued to counteract the discomfort and "muscle stiffness" induced by the new type of muscular action, and thereby encourage more persistent use of the prosthesis.

(c) Resistive exercises for the stump, likewise, diminish inversely with use of the prosthesis.

(d) Walking Reeducation: It is necessary for the leg or thigh amputee to develop a more defined sense of balance than he required before incurring his disability. This development in the relatively young patients seen in military practice is usually a rapid and spontaneous adaptation; it is present in a surprisingly high degree in most patients before the prosthesis is fitted; refinements in balance are necessary, of course, as soon as the prosthesis is worn.

Besides the requirement of this new sense of balance, the lower extremity amputee must acquire training in coordination in the muscles of the stump. Coordination is the most difficult phase of the retraining, especially in the case of amputation above the knee. If the amputation is below the knee, the patient learns to walk, stand and run with greater ease and requires a correspondingly smaller amount of tutoring. In the thigh amputee, considerable progress will be achieved in the preprosthetic period by the training of muscles such as the hip extensors and hip adductors by means of active resistive exercises; if the function of the hip joint has been maintained adequately, then short bone length remains the only other possibly adverse factor. Even this may be surmounted by the man who possesses considerable spirit, persistence and, possibly, some innate mechanical aptitude. In suitable cases, the tilting table may be incorporated into the prosthesis and will practically overcome the functional disadvantage of the short stump.

In cases in which the length of the thigh stump is more nearly ideal, a joint at the hip may allow motion in one plane or in two planes, according to the type of modification incorporated. There may be a lock or brake at the "knee," and there may be a simulation of normal motion at the "ankle."

The reeducational problem, then, will depend on many factors, not the least of which are bone length and mechanical advantages (or lack of them) in the prosthesis. The physical therapist must have some knowledge of all of these factors in order to give appropriate training in use of the artificial limb; the responsibility for prescription of the prosthesis, however, should rest solely with the orthopedic surgeon.

For coordination in the use of the thigh prosthesis (after the patient has learned to balance himself on it) the patient must learn to contract the adductors and the gluteus maximus muscle simultaneously in order to maintain alinement of the prosthesis by pressing against the bucket. The "knee" may be stabilized in extension by increasing this backward pressure. To walk, then, the stump is flexed on the abdomen; this provokes flexion at the "knee" and raises the foot from the floor. The early efforts are practiced on a runway consisting of stable parallel bars attached to a smooth floor, on which footstep silhouettes are painted a few inches ahead of one another. For coordination, the patient, after preliminary orientation, is encouraged to place his feet on these silhouettes; they should be so placed as to discourage a circumducted gait.

(e) Practical Points in Reeducation:

1. Nearly all patients have a tendency to abduct the amputated extremity and to lean toward the opposite side. They must be instructed to pull the prosthesis into normal mechanical line.
2. The lateral abdominal muscles must be brought into use. The patient is taught to lift the leg from the floor without leaning to the opposite side.
3. In the initial stages one must guard against the patient's leaning too far forward or bearing his weight (through the hands) on crutches or reeducational runways.
4. The patient should be taught to step forward with the good leg, and make the knee of the prosthesis bend by dropping the hip before carrying the leg forward, thus insuring natural walking. In the initial stages, the patient is allowed to scuff the toes of his shoes, but this is corrected later.
5. Care should be taken to be sure that the prosthesis is satisfactorily adjusted; the shoulder strap or pelvic band should be snug enough.

6. Crutches should be discarded for a cane and the cane thrown away as soon as possible.

7. The brace shop should adjust the prosthesis when three stump socks can be worn. The brace shop should be used whenever minor corrections of the prosthesis are indicated, because unless the patient has faith in the proper function of the prosthesis, he will become discouraged.

8. A mirror should be available so that the patient may see his mistakes at the same time that he hears the physical therapist giving him corrective directions.

(f) Contractures: Contractures in this war constitute a surprisingly small portion of the problem, although there appears to have been a slight incidence in this complication in below-the-knee stumps. When contractures do occur, the patient is placed on a contracture table, through which is suspended sufficient weight to elongate the contracted muscles. This specialized care is administered in the preprosthetic stage and is usually complete by the time the prosthesis arrives.

(g) Miscellaneous Measures: The use of heat and lubricants is generally contraindicated; exceptions to this rule are created by the presence of a circulatory disturbance or of some other complication or by the undertaking of treatment before plastic operation has been performed, in which case heat may be used if desired. Ultraviolet irradiation of the stump twice weekly is used for prophylaxis against the formation of furuncles in the skin of the stump; it is used, also, in the treatment of this lesion and in the treatment of small infections, abrasions and ulcerations, in order to expedite healing.

IV. Treatment in the Presence of Complications:

(a) Contractures: These have been discussed previously. In the more difficult cases, it seems advisable to use preliminary heating to the affected joint before exercising the muscles. For this purpose, diathermy appears to be the heating agent of choice; hydromassage tends to soften the skin, but is used for relief of pain and for treatment of some unhealed stumps.

(b) Circulatory Disturbances: If these are of minor nature, with simple terminal edema, no measures beyond those already outlined need be undertaken. If the arterial circulation appears embarrassed and the stump tends to be cold and cyanotic, diathermy may be used if there is an ulcer or nonhealing of the skin; if the skin is intact, contrast whirlpool baths, providing "vasomotor exercise," may be used effectively. This complication is serious enough so that toughening of the skin of the stump may be delayed to advantage. There have been no instances in our clinic wherein these measures have not been effective, presumably because of the highly skilled surgical treatment of the limbs. When the foregoing measures are ineffective, mecholyl iontophoresis may be applied to the greater portion of the stump (if deficiency is arteriolar or arterial); histamine iontophoresis may be used when the deficiency is chiefly capillary. If the circulatory deficiency persists for any length of time, the surgeon may consider further surgical revision, especially when the lower extremity is involved.

(c) Intrinsic Disease of Proximal Joints: The treatment is that of the cause. Generally, however, there will ensue some traumatic arthritis; I have found the most effective therapy to be a combination of diathermy and histamine iontophoresis, with therapeutic exercise within the tolerance of the joint. Treatment must be intensive in order to avoid the restricting influence of a stiff or painful joint, which limits reeducation in walking.

(d) **Extrinsic Disease of Proximal Joints:** Contractures have been discussed. Periarticular fibrosis is a common complication and is often associated with intrinsic joint disease and contractures, but more frequently occurs alone. It is wise to treat it in the same manner as traumatic arthritis, but with more rapid progress toward intensity of exercise. Dense periarticular adhesions, particularly if these are superficially located, may respond best to the use of the paraffin bath, with the coating applied three times daily and allowed to remain in place (wrapped with a towel) for two or three hours. If the joint is accessible and the history for the complication has been more than two months in duration chloride iontophoresis is most effective in softening the tissues. (The galvanic bath is safer than pad electrodes, but the latter must be used in inaccessible areas.) After application of either or both modalities, intensive assisted and resistive exercise should be carried out several times each day. Wedge splinting may be used at night. A common extrinsic involvement is that due to muscle weakness. The prevention is more important than the treatment because if the condition is neglected contracture and other complications have a tendency to occur. Static exercises begun very early in the hospital course (preoperatively) are most effective. These may be resumed as early as forty-eight hours after operation. When marked atrophy is present, graded exercises, passing as rapidly as possible to considerable resistance, are indicated several times each day. When large numbers of patients are involved, after the preliminary stage, wherein resistance by the operator is used, resistive pulleys may be used satisfactorily if intelligence is used in varying the weights.

(e) **Multiple Amputations:** The sense of adapted balance is often difficult to develop in the case of multiple amputations. If there is bilateral involvement below the knee, the problem is not so difficult. Combined upper and lower extremity involvements are difficult and require prolonged reeducational supervision, with considerable psychotherapy and the constant use of a stable reeducational runway (so that the patient may avoid the use of canes or crutches with his amputated upper extremity, and yet feel perfectly secure from the danger of falling sideways).

(f) **Fractures in the Stump:** These delay the care of the amputation *per se*. In addition, overriding and angulation may be encountered; the prosthesis is then uncomfortable and reeducation likely to be far from satisfactory until realignment is effected surgically. The delay in amputation care may be fraught with a greater danger of complications, but the delay is necessary and is justified by the more satisfactory response to reeducational measures.

Fractures in areas other than the amputated stump may also hamper the reeducation. This is especially true of fractures (or peripheral nerve injuries) of the opposite lower extremity, because of the delay necessary, as well as because pain or stiffness in the nonamputated extremity may cause abnormal balance of weight in walking.

(g) **Short Bone Length:** This is primarily a surgical problem, but it affects directly the prognosis for efficiency in use of the prosthesis. Sometimes, also, in order to conserve bone length when the amputation is already high, the surgeon's judgment dictates that soft tissue or other defects be ignored in order to avoid further bone shortening; the physical therapist may then expect difficulty in the mobilization of broad-based, irregular, adherent skin scars, which are often restrictive of motion. Paraffin baths and mobilizing massage may be effective over a treatment period of considerable duration if supplemented by intensive active and resistive exercises.

Efforts to overcome such restriction of motion are essential prerequisites to satisfactory use of the prosthesis later.

(h) Disability in the opposite lower extremity has been adequately discussed under "Fractures in the Stump."

(i) The Inept Patient: Such a person is occasionally encountered; because of lack of intelligence, lack of cooperation, or, rarely, a desire for sympathy, he will never use the prosthesis well, no matter how satisfactory the stump may be surgically and regardless of the patience, skill and application of the physical therapist. Fortunately, such patients are rare.

(j) The Obese Patient. Weight reduction is a necessity in the obese patient whose lower extremity has been amputated, so that ambulation will be easier and undue pressure effects of the prosthesis on the stump avoided.

V. Liaison Between the Physical Therapy Clinic and the Ward Officer or the Limb Fitter: When large numbers of patients are involved in a program, the physical therapist may be the professional person in most frequent contact with the individual patient. She should consider it her duty to supply whatever information may be desired by the ward officer or the amputation officer concerning the progress of the patient. Early signs of the need for prosthetic adjustment may first come to her attention because the need will be reflected in the patient's difficulty in walking, etc. She may discover abrasions of the skin or other complications which the patient is shielding from his ward officer or considers to trivial to bring to his physician's attention.

VI. Swimming: I am enthusiastic concerning the value of swimming as general body exercise. Moreover, I feel strongly that every amputee should have the opportunity before leaving the hospital of determining the balance corrections in swimming which are necessitated by his handicap. However, it seems contradictory to employ swimming, which softens the skin, in the preprosthetic stages (at the very time when every effort is being exerted to toughen the skin by the profuse use of alcohol). Therefore, I believe that all patients should undertake swimming practice or instruction during hospitalization, but not until near its completion, when the skin should be toughened sufficiently so that it will resist the softening properties of water.

B. *Arm Amputations.*

I. Massage: In the case of amputation of an upper extremity less attention needs to be paid to the stump face, but the massage, although it may be brief, must be extended to the musculature above the next one or two joints cephalad. Operation of an upper extremity prosthesis requires utilization of the musculature in a different type of function than is present in the normal arm. For this reason, considerable discomfort and stiffness may be experienced in the earlier stages of prosthetic use, and this disability is counteracted by massage. It is believed that the method used on leg stumps should be used for toughening the skin across the shoulder blades (in the areas traversed by the operational thongs of the prosthesis). If this is not done, considerable irritation of the skin is experienced in the early prosthetic period, with resultant abandonment of the prosthesis. While weight bearing is not a problem, tapotement is included in the treatment in order to render the stump face pain free and thereby encourage greater use of the prosthesis.

II. Exercise: There is a tendency after amputation in the forearm to restriction in pronation and supination and after amputation in the upper arm to adduction deformities. Corrective exercises are undertaken to elim-

inate these two common defects and to provide full range of motion in all joints of the extremity and good turgor in the remaining musculature.

III. Bandaging: This is utilized in the preprosthetic period according to the same principles as those employed for the leg, but to a more limited degree.

IV. Treatment of Complications: This has been discussed under "Exercise" Otherwise the complications may be similar to those noted for leg amputations.

V. The Prosthesis: The upper extremity prosthesis is constructed of materials of the same type as those used for the leg prosthesis. To the end of the prosthesis is attached a two-pronged hook or an artificial hand. To the hook is attached a series of operational pulleys which, under the influence of manipulation of the shoulder girdle's musculature, open and close the hook. At the base of the prongs of the hook, rubber bands of considerable tension are attached to provide grasping pressure. In the case of forearm prostheses, natural elbow motion is used; in the case of upper arm prostheses, it is usual to have a three position adjustment of an artificial elbow.

In the preprosthetic period the aim is to perfect the use of the non-affected extremity, particularly so far as commonplace attainments are concerned, and, by adapted appliances, to provide work therapy for the stump in continuation of the physical therapy. The normal "handedness" and the bone length, plus the innate mechanical tendency of the patient, greatly affect the amount of skill likely to be acquired. If the amputation was in the "handed" side, relatively less training in the use of the prosthesis will be needed than if it had been in the "nonhanded" side. So far as the nonimpaired member is concerned, however, unless the patient is ambidextrous, much more time will be needed for preplastic training of the nonhanded, nonaffected extremity, because it has always been the less skillful one. The problems created by stumps above the elbow level are merely greater than those created by amputation at lower levels. In general, the first concern of physical therapy, both in the stump and in the normal extremity, is to develop skill in commonplace procedures, such as eating, writing and dressing. The preprosthetic period may be utilized also in teaching the patient various simple things, such as what kind and color of cloth to buy for shirts for summer wear in order to keep cool with his sleeves rolled down, or what type of belt buckle to buy, or the replacement of buttons by hooks on some garments, and so on. Later on, when his own prosthesis has arrived, he is taught more complicated things, and special stress is placed on the accomplishment of these with the prosthetic, as well as with the normal, hand.

Kessler has pointed out that relatively few upper extremity amputees use their prosthesis except for dress purposes. It is our intention to attempt to improve this situation and to encourage functional use of the upper extremity prosthesis by pooling mechanical adaptations and ideas and by providing a great deal of practice under favorable circumstances. It is believed that if the patient develops sufficient skill, he will continue to wear his prosthesis. Certainly, except when bone length is so short that proper use of the prosthesis is functionally unsatisfactory, this should be possible. A parachute officer writes beautifully with the prosthetic hand and ties his own shoelaces, despite the fact that he has merely a nubbin of the humerus remaining. The physical therapy section in our installation does not provide instruction in the functional use of the prosthesis; this reeducation is delegated to the occupational therapy section.

Summary

1. The proper care of the soldier who has lost a limb requires employment of the coordinated skills of the surgeon, the limb fitter and the practitioner of physical medicine.
2. The amputee should be kept occupied by a full day of activities, which, besides the ones already enumerated, should include calisthenics and games, occupational therapy and educational pursuits.
3. If proficiency in the use of the prosthetic appliance is developed properly, the amputee should be able to pursue a gainful occupation and assume a normal place in the community. He is not "crippled"; he is "handicapped."

Discussion

Capt. Louis N. Rudin (Cleveland): Capt. Dow has presented a most excellent, comprehensive, all inclusive paper on the physical therapy of the military amputees, as practiced in army amputation centers.

While the directives from the Surgeon General's office are specific in prescribing the treatment and excellent results are obtained, it is worth while to point out, that there exists here and abroad a great deal of controversy among the leading men in this field, as to the proper use of massage, hydrotherapy and diathermy in the treatment of amputations.

It is well to realize that the best treatment at times is the one designed to fit the individual case, and anything based on sound anatomy and physiology, which tends to promote an ideal amputation stump, should be used.

At Crile General Hospital we receive a number of amputees from the battlefield, after the guillotine operation has been done in a field hospital. By far the greatest number of amputations of the lower extremities were caused by land mines. Our mission is to transfer these cases to amputation centers, as soon as possible, for the final revision of the stump and the

fitting of a prosthesis. While the amputees are at the hospital, awaiting transfer, we treat them as described by Captain Dow to suit the particular stage of the amputation. Most of the cases require skin traction. While in the average case, hydrotherapy and thermotherapy are contraindicated because they tend to soften the stump, many of our cases have had a low grade inflammatory condition and cold cyanotic painful stumps. We used whirlpool baths at temperatures of 105 to 110 F. to which a bactericidal agent has been added, and we were quite successful in clearing the exudate and improving the circulation. We have also used ultraviolet irradiation in some cases, where small indolent ulcers have developed over the stump. On the wards, we take the amputees out of traction and give them daily massage, and therapeutic exercises to correct deformities. After massage and exercise the stump is firmly bandaged by the Vogel method, using elastic bandages. Our physical therapists have taught some of the patients to bandage their own stumps, of the lower extremity. Of all the measures, no one is more effective towards the production of ideal stumps at this stage than the proper traction and pressure bandaging.



PERIPHERAL VASCULAR REACTIONS AFTER SYMPATHECTOMY *

KARL HARPUDER, M.D.

NEW YORK

The immediate effects of sympathetic denervation on the limbs are well known from animal experimentation and therapeutic experiences with human beings.

They can be classified as follows:

1. Complete release of neurogenic vasoconstrictor tone and neurogenic vasomotor activity. The vascular denervation involves the peripheral circulation from artery to capillary and vein. It results in:

(a) An increased blood flow through the skin, demonstrable under all conditions under which the innervated blood vessel maintains tone and is not completely dilated.

The question of a sympathetic constrictor innervation of the vessels of muscle is still under discussion. In my opinion the more recent evidence favors the assumption of sympathetic vasoconstriction in the resting muscle in contrast to a vasodilator effect in the contracting muscle. The effect of sympathectomy on the blood flow in muscles needs much further investigation.

(b) An extinction of all efferent-neurogenic vasoconstrictor and vasodilator reflexes. These include thermoregulatory reflexes on exposure to cold or heat, the vasoconstrictor effect of inhalation of carbon dioxide, vasomotor reflexes originating in the carotid sinus and aortic arch and the effects of painful skin stimuli. They do not include reflexes in which the efferent pathway releases and makes use of a humoral mediator substance, as in the release of epinephrine during fright and struggle.

2. Hyperreactivity of the denervated blood vessels to appropriate direct chemical stimuli, such as circulating epinephrine. This appears about seven days after denervation, reaches a maximum within about three weeks and is thereafter maintained for a long time or diminishes slowly. It is more marked after postganglionic than after preganglionic denervation. Hypersensitivity is not a characteristic of the denervated blood vessel but develops in all denervated effector organs, e. g. the muscle end plate, or in synapses. Probably it does not only concern the transmitter substance of the severed nerve but also concerns other stimuli of the effector organ.

3. Sudorific paralysis. Sweat glands are innervated by fibers within the sympathetic system, although they are cholinergic effectors and the transmitter substance is acetylcholine and not epinephrine. After sympathectomy, reflexly stimulated thermoregulatory or emotional sweating disappears. According to Sheehan, direct stimulation of sweat glands with injected acetylcholine or pilocarpine produces sweating after degeneration of sympathetic fibers but not after peripheral nerve section. Hyndman assumed that these substances remain effective only after preganglionic and not after postganglionic sympathectomy.

Other effects of sympathectomy, such as so-called trophic or metabolic influences and effects on growth and calcification of bone, are doubtful and will not be discussed.

* Read before the Twenty-Third Annual Session of the American Congress of Physical Medicine, Cleveland, Sept. 6, 1944.

The known over-all effect of sympathectomy on the limbs in human beings is a permanent maximum blood flow through the skin. The skin is hot, bright red and dry, regardless of environmental temperature and emotional and other vasoconstrictor stimuli.

Frequently, however, a return of vasomotor tone and activity is observed weeks or a few months after sympathectomy. This may be the result of reinnervation, most common in cases of postganglionic section. In other cases the return has been explained by the hyperreactivity of the denervated blood vessels, also most marked after postganglionic operation.

Successful sympathectomies have been followed up in animals and human beings for two to four years, after which the results have been considered permanent.

Herrick and associates¹ have recently reported observations on a dog made approximately one year and again ten years after unilateral lumbar sympathectomy. While the blood flow in the sympathectomized limb was about 200 per cent, that of the control limb one year after operation, it was only insignificantly more than that of the control limb ten years after ganglionectomy. The denervated blood vessels maintained their hyperreactivity to injected epinephrine even after ten years. The denervated arteries showed anatomically a hypertrophy of their muscular lining.

In view of Herrick's observations on this sympathectomized dog, it seems important to reexamine human beings at similar intervals after sympathectomy. I had an opportunity recently to study two patients in this manner.

CASE 1. — The patient was a 30-year-old woman with Raynaud's syndrome on all extremities and inactive rheumatic heart disease. A bilateral cervical sympathectomy was performed in 1929, a bilateral lumbar sympathectomy in 1930 and arterial stripping of the right upper extremity in 1931. The operations for the upper extremities produced a temporary Horner's syndrome on the left side but no relief of the symptoms of Raynaud's disease. In the lower extremities all signs of vasoconstriction disappeared permanently. A tendency to infections developed in the left large toe. My observations were made during May and June, 1944, fourteen and fifteen years, respectively, after sympathectomy.

General Observations. — The toes and feet were always bright red and felt hot and dry to the touch. The veins on the dorsum of the left foot were engorged. The temperature of the legs and thighs always appeared lower than that of the feet. The appearance and temperature of the fingers varied from purplish mottled or pale and cold to dark red and moderately warm or even hot. The pulsations of the large arteries were readily observed in all four extremities. Oscillometric readings were high normal, a little higher for the left extremities than for the right. The readings for the ankle and foot were unusually high in relation to the readings for the calves; for example, the reading for the left ankle was 4, to 5½ below the left knee. Skin temperatures at a room temperature of 74 F. were 90 F. for the toes and ankles and 86 F. for the calves, a reversal of the normal drop of skin temperature from proximal to distal. At the same time the temperatures of the upper extremities declined normally from 90 to 91 F. for the forearm to 86 F. for the finger tips.

Heat Applications. — Heat was applied to the upper extremities in the form of a Landis-Gibbon test. Both upper extremities were immersed up to the middle of the arms in water of 110 F. for thirty minutes. The patient, including her feet, was covered with blankets. The room temperature was 74 F. The temperature of the toes rose slightly, to 92 F. There was marked sweating over the whole body except the ankles and feet, which remained dry. The immersed fingers became bright red from hyperemia.

Similarly, the lower extremities up to the knees were immersed in water of 108 F. for thirty minutes with the room temperature at 70 F. The temperature of the left index finger rose from 75 to 78 F.; that of the right index finger, however, climbed from 75 to 86.5 F. Sweating was slight on the left upper extremity and marked on

1. Essex, H. E.; Herrick, I. F.; Baltes, E. I., and Mann, F. C.: Observations on the Circulation in the Hind-Limbs of a Dog Ten Years Following Left Lumbar Sympathetic Ganglionectomy, *Am. J. Physiol.* 139:351 (July) 1943.

the right upper extremity and hand. The immersed feet were bright red from hyperemia.

The direct local effects of heat offered nothing of interest. The reflex action of heat on the feet and toes produced a slight increase in skin temperature without any sweating. This could possibly be interpreted as an effect of nonsympathetic vasodilator fibers. A relatively low finger temperature rose under reflex heat stimulation much higher and with more intensive sweating on the right side than on the left, although sympathectomy and stripping operations had been performed on the right. Obviously the sympathetic supply to the right upper extremity is more responsive than that to the left.

Cold Applications. — Both upper extremities were immersed in water of 56 F. for thirty minutes. The room temperature was 76 F. The patient was clad in light pajamas, and the feet were in slippers without stockings. The temperature of the toes of both feet rose from 90 to 91.5 F. Simultaneously the temperature of a midleg area dropped 3 degrees, from 86 and 87 F. to 83 and 84 F., respectively. The immersed fingers were dark red and the right third finger purplish. The temperatures of the fingers fifteen minutes after exposure were around 70 F. and thirty minutes after exposure were 72 F. (The room temperature was 76 F.) The patient had no pain.

Again both lower extremities were immersed in water of 56 F. for thirty minutes with the room temperature at 74 F. The temperature of the left fingers dropped 2 degrees and that of the right 5 degrees, while the temperature of the wrists and forearms remained practically unchanged. Of the exposed toes, pallor developed on the right second and the left third and was maintained for at least fifteen minutes. All the other toes were bright red.

The first three toes of the left foot and the forefoot were packed in ice for ten minutes. The last two toes had no contact with ice. The room temperature was 74 F. There was no pain. All the toes remained bright red, and the fourth and fifth toes were warm throughout this procedure. Tingling appeared in the exposed toes. The temperature of the large toe was 88 F. before the experiment, 82 F. two minutes after it and 87 and 89 F. at five and fifteen minutes, respectively.

When the second and third fingers of the right hand were packed in ice, pain appeared after eight minutes. The temperature of the third finger diminished from an original 78 F. to 63 F. two minutes after exposure and was elevated to 82 and 84 F. at eight and fifteen minutes, respectively. The color of the finger changed from dark red over purplish to bright red within eight minutes.

Apparently the sympathectomized feet of this patient reacted to a reflex cold stimulus with an increase in skin temperature. Whether this meant a paradox vasodilator action in the absence of constrictor fibers or was the result of systemic cardiovascular changes could not be decided. The blood pressure showed no definite increase. The legs and fingers exhibited the expected vasoconstriction. As in its reactivity to the heat reflex, the right upper extremity responded more intensively than the left to the reflex cold stimulus. Direct application of moderate cold over a longer period and on a larger surface area resulted in the fingers in a prolonged vasoconstriction compatible with a diagnosis of Raynaud's syndrome; only one toe of each foot showed vasoconstriction under similar conditions. Severe traumatizing cold on a small surface area caused in the fingers a fairly fast reactive hyperemia which elevated the skin temperature above the preexperimental level. Apparently locally released tissue constituents with vasodilator action overwhelm vasoconstrictor influences. No tendency to vasoconstriction was observed in the sympathectomized toes under the same circumstances. A maximum blood flow was maintained throughout the experiment.

Reactive Hyperemia. — After a five minute arrest of circulation with a blood pressure cuff inflated to 200 mm. of mercury around the arm, an intensive flush appeared on the left hand and fingers within two seconds; the same procedure applied on the left calf caused a faint flush on the left foot and toes after ten to twelve seconds.

When the patient performed contractions of the left hand and foot after arrest of circulation fatigue and pain appeared about equally in the sympathectomized lower and the upper extremity.

There was obviously still a reserve of inactive noncirculated small blood vessels in the skin of the sympathectomized foot which responded to locally released vasodilator substances. The upper extremity had a much greater circulatory reserve, however. Why the appearance of the flush on the foot was markedly delayed was not clear. One might hypothetically think of a loss of vaso-vascular reflexes as a result of sympathectomy. Sympathectomy does apparently not prevent the appearance of ischemic pain.

A procaine hydrochloride block of the left superficial peroneal nerve produced

anesthesia of the medial part of the dorsum of the foot and of the large toe except at its tip. There was an increase in skin temperature of 1 degree, which occurred, however, simultaneously in the right foot. Peripheral nerve block did not elevate the skin temperature of the sympathectomized foot.

Pharmacologic Reactions. — It was considered best to apply vasoactive drugs intradermally to observe their local effects on the skin circulation. Intravenous application, as used elsewhere, may cause systemic cardiovascular rearrangements which interfere with local effects.

Epinephrine hydrochloride (1:10,000, 0.1 cc.) caused a hemorrhage 0.5 cm. in diameter in the left foot followed by blanching of an area 3 cm. in width and the appearance of extended blanched streaks. In the blanched area the temperature dropped from 88 to 85 F. On the left hand a hyperemic center 0.25 cm. in diameter was surrounded by a blanched ring 2 cm. in width.

Histamine biphosphate (1:10,000, 0.1 cc.) produced on the left foot a high, pale pink wheal 3 cm. in diameter surrounded by a flush only 0.5 cm. wide. On the left hand the wheal measured 1 cm. and the flush 1.5 cm. An injection of 0.1 cc. 0.25 per cent mecholyl chloride was followed on the left foot by a wheal 1 cm. in diameter and a flush 0.5 cm. wide. The respective measurements on the left hand were 0.5 and 1.5 cm. The flush was more intensive on the hand. No local sweating occurred on the foot, while the iodine-starch test gave a slight positive reaction on the hand.

The denervated blood vessels of the foot responded to epinephrine more intensively than those of the hand. The vasodilators histamine and acetylcholine produced a larger wheal but a less marked flush on the foot than on the hand. The hemorrhage caused by epinephrine and the large wheals point to an increased permeability and vulnerability of the walls of the denervated capillaries.

Smoking of a cigarette, painful faradic stimulation, pressure on the carotid sinus and sudden change from a reclining to an erect position had no influence on the skin temperature of the feet.

CASE 2. — The patient was a 46-year-old man with thrombo-angiitis obliterans who had a bilateral lumbar sympathectomy performed in 1935. Although pulsations could not be felt in either lower extremity and oscillometric readings were very low, the patient was able to walk around and work as a shoemaker without discomfort. The toes and feet were bright red and warm, the fingers pale, cold and moist. There was, however, an approximately normal temperature gradient from the left thigh, with 90 F., to the left large toe, with 85 F., while on the right side the readings were 90 and 88 F., respectively. Heat applied to the upper extremities raised the toe temperatures about 3 degrees and caused sweating of the whole body, including the left foot, while the right foot remained dry. Immersion of the upper extremities in water of 54 F. resulted in an elevation of the toe temperatures of about 2 degrees, as in case 1. However, immersion of the lower extremities in water of 55 F. for forty minutes raised the finger temperatures from 89 and 88 F. to 91 F., and profuse perspiration appeared on both hands and fingers. The direct effect of this moderately low temperature on the toes was prolonged vasoconstriction, while after application of ice the skin temperature and color returned to normal within about ten minutes. The injection of histamine and epinephrine showed no definite differences between the right and left foot and the hands.

Comment

The first patient was studied and reported on in greater detail because in all probability the peripheral circulation is not interfered with by gross anatomic changes in blood vessels. The second patient's condition was obviously complicated by intensive anatomic disease of the blood vessels. The only safe conclusions in this instance are, first, that nine years after bilateral lumbar sympathectomy the skin temperatures of the feet were high in spite of occlusion of the larger arteries and, second, that the reflex vasoconstrictor response to cold was absent. Thermoregulatory sweating was missing from the right foot, where the success of sympathectomy is probably more complete or better sustained than on the left. In the first case it is assumed that sympathectomy was a complete failure in its effect on the upper and a complete success in its effect on the lower extremities. The characteristic effects of sympathectomy, as outlined in the beginning of this paper, were fully maintained over a period of fourteen years. This is in contradistinction to results observed in a dog ten years after lumbar sympathectomy. Some

of the observed details are of interest or deserve further study, e.g.: the paradox reaction to a reflex cold stimulus; the lack of response of the denervated blood vessels to moderate as well as to severe cold; the increased permeability of the denervated capillaries; the presence of an inactive circulatory reserve, utilized under the influence of local vasodilators; the delayed appearance of reactive hyperemia and the absence of a reaction of the denervated sweat glands to injected acetylcholine. These observations were limited almost entirely to the circulation of the skin and its reactions. An intended further subject of study will be the circulation of the muscles.

MINERAL WATER THERAPY: AN APPRAISAL

M. B. JARMAN, M.D.

Medical Director, The Homestead Spa

HOT SPRINGS, VA.

My only qualification for discussing the subject of mineral water therapy is this: Seventeen years ago I found myself practicing medicine at an American spa, or health resort. Here I found at my disposal a set of tools entirely new to me. These tools consisted of an abundance of spring waters which had for a long time been referred to as mineral waters and said to be useful in the treatment of patients. Along with these waters there were some equipment and a staff of attendants organized for the application of these waters in therapy. My previous training as a medical student, intern and resident had taught me nothing as to the use and little as to the existence of these tools. I set out to evaluate them solely for my own use.

I was eager to find out what was meant by the term mineral water and to learn whether or not mineral water had a legitimate place in therapy. I have no broad background of first hand experience with many different mineral waters and I do not pose as an authority on this subject. The comments, observations and opinions recorded in this paper are based on my attempt to evaluate mineral waters for my own use and on my experience during the past seventeen years at a spa.

What is a Mineral Water?

I first attempted to find out just what is meant by the term "mineral water." I could not find then and have not since found an entirely satisfactory definition. Proposed definitions vary greatly and more often than not depend on the point of view of the proposer. The geologist defines a mineral water as "One derived from deep-seated natural sources." The chemist thinks in terms of the amount of dissolved minerals contained and usually has an arbitrarily set minimum, such as a gram of dissolved matter to a liter of water, as one of the specifications. From the medical point of view mineral water has been defined as "One from natural sources which has therapeutic value." The Quality of Water Division of the United States Geological Survey finds it convenient for statistical purposes to define mineral water as "One sold in a bottle."

The International Food Congress held in Paris in 1909 adopted the follow-

* Read before the Twenty-Third Annual Session of the American Congress of Physical Medicine, Cleveland, Sept. 6, 1944.

ing definition: "A mineral water is a natural water proposed for consumption on account of its special therapeutic or hygienic properties." I found many other definitions, but in actual practice in the past a mineral water was any natural water which interested persons chose to call a mineral water. This was not as it should have been but as it far too often was.

The Literature

In order to find answers to the questions as to what is meant by a mineral water and whether or not such waters have a place in therapy I naturally turned to the literature. One of the first things which came to my attention was a pamphlet published in 1923 by the propaganda department of *The Journal of the American Medical Association*. It listed sixty-two mineral waters against which rulings had been rendered by government agencies because of false labelings and false claims. On the cover of the pamphlet was this quotation: "Mineral waters possess no mysterious or occult virtues in the treatment of disease. No mineral water will be accepted by the medical profession for alleged medicinal properties supported only by testimonials from bucolic statesmen and romantic old ladies."

While this was discouraging, it occurred to me that few, if any, therapeutic measures now in use possessed "mysterious or occult virtues." Neither could I recall any that had been accepted by the profession on the basis of testimonials of "bucolic statesmen and romantic old ladies." Many have been accepted in spite of testimonials from the sources mentioned. So has mineral water therapy been accepted to varying degrees by a large section of the medical profession in spite of exaggerated claims made by persons financially interested and testimonials from "romantic old ladies" and their masculine counterparts.

I soon became convinced that time has answered the question as to whether mineral waters have a place in therapy; when judged solely by the test of time they have few equals.

As I continued to examine the literature I found a surprisingly large number of contributions on the subject, and their number seemed to increase as time passed. An examination of the published articles showed that most of them were written by Europeans and contributed to foreign language journals, that many were devoted to descriptions of some feature of a particular spring or spa, that radio activity and catalytic agents in waters were frequently discussed, that many collections of case reports were included and that from time to time it seemed desirable to submit a new classification of mineral waters if for no other purpose than to direct attention to the fact that existing classifications were not entirely satisfactory.

I consider this mass of literature evidence of interest in the subject, but papers of high scientific level were certainly not numerous.

Hydrotherapy

I soon became convinced that no clearly defined line of demarcation could be drawn between "mineral water" and "ordinary water." Some "ordinary water" contains a much higher mineral content than does some "mineral water." For this reason I felt that much, if not most, of the value of mineral water depends on principles of ordinary hydrotherapy; in other words, that the value of any particular mineral water depends on the value of hydrotherapy plus the adaptation and utilization of whatever special properties the mineral water has to offer.

As to the value of hydrotherapy there can be little doubt. It is not necessary to stress this to members of the American Congress of Physical Medicine. One needs only to focus attention on a daily routine in any institution in which sick people are treated in order to see many illustrations of water therapy so

fixed by habit and so commonplace that they are taken for granted and rarely thought of as water therapy. Hydrotherapy is extensively used in the treatment of both acute and chronic diseases; mineral water therapy is for the most part used in the treatment of patients suffering from chronic diseases. I shall not list here the types of patients who resort to mineral water treatment. In general the patrons of spas, where most mineral water therapy is administered, are middle-aged and elderly men and women who are well and want to remain so and men and women of the same age group who are suffering from certain of the chronic diseases or are convalescing from surgical operations or acute diseases.

Some Useful Attributes of Water

Ordinary water has certain attributes to which it owes much of its value. Some of these are as follows:

- (a) Its abundance and therefore its cheapness and availability.
- (b) Its wide distribution.
- (c) The relative ease with which it can be kept pure from a sanitary standpoint or purified when contaminated.
- (d) Certain of its chemical and physical properties; namely, its power as a solvent—"no other solvent surpasses it"; its high specific heat; its power of accelerating many chemical reactions, and the ease with which it may be converted from the liquid to the solid or gaseous state.

Mineral water possesses these attributes plus others which are peculiar to the particular water under consideration.

Methods of Administration

For purposes of therapy water can be administered by many methods which I shall not list. Mineral water is administered chiefly by mouth and by application to the body surface and sometimes by inhalation. Mineral water given by mouth may perform the functions of "ordinary water" and be of additional value for the following reasons:

- (a) Many waters are bottled at their source under sanitary conditions and widely distributed. These are satisfactory waters and pure from a sanitary standpoint. They are valuable for drinking when there is doubt as to the purity of other available water. In other words they have their place in preventive medicine, not because of their mineral content, but because of the sanitary methods used in their distribution.
- (b) Many persons who travel extensively find it desirable to select one of the widely distributed bottled waters in order to insure uniformity in the quality of water. A "change of water" is blamed by patients for many of the bodily ills of persons who are subjected to such change.
- (c) In many instances administration of mineral water is the most effective means of getting the patient to take enough water.
- (d) Some waters contain magnesium sulfate and sodium sulfate in sufficient quantities to act as saline cathartics. When a saline cathartic is needed these waters will serve the purpose, and at spas where they occur they are very useful, but few patients find it necessary to go to an American or a European spa or even to use bottled water in order to get a saline cathartic.
- (e) Water is one of the best of diuretics. Some mineral water is used for this purpose.
- (f) Certain deficiencies, such as lack of calcium in rickets or in tetany, of sodium in Addison's disease or of iron in secondary anemia, might be supplied by mineral water. This means that the prescribing physician must be familiar with the contents of the prescribed water. Such familiarity with the contents of mineral waters is not at present widespread; but with this knowledge in mind physicians at spas can and often do make use of the waters at hand for drinking purposes in planning the regimen of a spa.
- (g) Some mineral waters contain free carbon dioxide gas. When taken internally this is said to "stimulate the mucous membranes of the upper gastrointestinal tract, inducing better circulation in these membranes and a consequent improved secretion of the gastric ferments."

(h) The importance of minute traces of some elements in the maintenance of health is recognized. Mineral waters supply a source of some of these elements of known value.

In this connection it may be said that there are authorities who feel that some natural waters possess peculiar therapeutic properties — now resting on an empiric basis — which will be established scientifically at some future date, when the methods of scientific investigation shall have been improved sufficiently and applied to the solution of the problems involved. Well known examples, which I shall not cite, in the history of medicine give support to this feeling.

When claims are made for unusual therapeutic value of waters, suggested explanations often include reference to "catalytic agents" or "radioactivity." Investigations in these fields may in the future explain in scientific terms some of the results of mineral water therapy which now rest on an empiric basis. It is sometimes claimed that chemicals occurring in natural waters will bring about a pharmacologic action different from that of the same chemicals derived from other sources when administered in the same dosage. Physicians usually become skeptical when such claims are made, but it may be that improved methods of investigation will show that chemicals which are now believed to be the same are in reality not exactly the same. When all things are considered it is not likely that unusual claims made for mineral waters will be recognized by the medical profession unless such claims can be established by scientific standards of the level applied in the evaluation of other therapeutic measures. Even so, physicians of spas have learned in many instances to make use of the waters at hand for drinking purposes in planning the regimen of the spa, and in the effect that drinking mineral water has on the feeling of well-being of the patient, it is by no means the least important part of such a regimen.

Baths

Just as ordinary water is administered in a great variety of baths in the treatment of a great variety of patients, so mineral water is used in a great variety of baths in the treatment of a great variety of patients. When mineral water is used for this purpose advantage is taken of whatever peculiar properties it may have in application of the principles of balneotherapy. For example, when naturally carbonated water is available it is used for the Nauheim bath, and when naturally hot water is available it is a matter of ordinary common sense to use it when the temperature of the bath is a prime consideration. Except in the Nauheim bath and certain artificially medicated baths of the type used by dermatologists, the physical factors involved, such as temperature, pressure and friction, are more important than the chemical content of the water. Mineral water baths are usually given at spas.

Spas

Mineral water therapy cannot be appraised without giving attention to spas, the distinguishing feature of which is spring water. The word "spa" means more than simply a mineral spring or group of springs. It signifies a mineral spring or group of such springs around which there have been developed institutions designed to utilize the spring water at its source in conjunction with other standard therapeutic agencies for health purposes. At some spas drinking the water is stressed. At others baths are featured. At many the two are combined and, what is far more important, they are combined with other fundamental health-promoting and health-preserving procedures — rest, exercise, diet control, suitable climate, stimulating environment and something which for the want of a better term is called "atmosphere."

Several years ago Dr. E. H. L. Corwin, in discussing the spas of Europe, stated, "The fact that constantly increasing numbers of patients patronize spas

must be taken as an indication that hundreds of thousands of people consider the effects of the treatment at the spas beneficial." Efforts have been made to explain in scientific terms the results obtained. Clinical evidence is abundant, but the scientist wants (and must have, if he is to continue to be a scientist) something more than clinical evidence on which to base conclusions.

When an attempt is made to evaluate spa therapy the question arises as to whether the benefits derived are due to specific properties of the mineral waters used or to a combination of many factors which make up the spa regimen. Available evidence would seem to indicate that the benefits are due to a combination of the factors mentioned and possibly in some instances to additional factors inherent in particular waters which are yet to be explained but which may some day be explained in terms of new theories or new knowledge gained by intensive investigation of the waters.

Attributing results to such things as climate, environment, "atmosphere" and combinations of therapeutic measures will hardly satisfy the medical scientist, who wants exact explanations. The patient who associates his improvement with this regimen and the "medical artist" will not be so exacting. Every physician would like to be able to base all of his practice on science. This is the ideal, but has any branch of medicine realized this ideal? In all branches of medicine, in proportion as we are ignorant, that is, lacking in the science, we must resort to the "art." I have a feeling that the popularity of mineral water therapy through the centuries has depended to no small degree on the numerous "medical artists" who have applied their talents to its administration.

Mineral water therapy as it is now practiced rests chiefly on an empiric basis, but on this basis it is well established. Spa therapy, because it is a combination of many therapeutic aids, has a mixed rational and empiric basis. The ideal spa would provide all of the usual therapeutic agents of value in the treatment of patients suffering from certain of the chronic diseases plus additional aids not available to the ordinary institution or individual physician treating patients in the home.

The Future of Mineral Water Therapy

The future development of mineral water therapy should be in the direction of establishing it on a rational basis. In the meantime it should be accorded the openmindedness which is an attribute of the scientist. Dr. Henry Christian has said, "An intelligent skepticism assuredly is needed by practitioners now as in past years." This I believe to be a timely quotation. I believe, however, that as much emphasis should be placed on "intelligence" as on "skepticism." Neither extreme skepticism nor gullibility makes for a well balanced practitioner of medicine.

Hope for the rationalization of mineral water therapy seems to me to rest on these developments:

1. Interest in this subject on the part of the medical profession in America, which has increased since the first World War and has grown rapidly since the beginning of the present World War.
2. Efforts on the part of the federal government to separate the true from the false in matters pertaining to the mineral waters of this country.
3. Organization by the American Medical Association of the Council on Physical Therapy, now called the Council on Physical Medicine, a group of reputable physicians with official status whose function it is to perform the same duties with reference to physical therapeutic agents as does the Council on Pharmacy and Chemistry with reference to drugs.
4. Recognition by the American Medical Association of the existence of health resorts, many of which are built around the use of mineral waters. These

resorts have been deemed of sufficient interest to the medical profession to warrant the appointing of a committee on health resorts by the Board of Trustees of the American Medical Association.

5. Recognition by the medical authorities of the armed forces of the value of spas in the rehabilitation of war casualties. A number of spas are already being used for this purpose. There is good reason for believing that this practice will be extended to industrial medicine after the war.

6. Increased attention in medical schools to all forms of physical therapy. The leading teaching hospitals now have well organized departments of physical therapy. The recent grant to the University of Pennsylvania for the establishment of a center for research and instruction supplies concrete evidence of the trend in the right direction.

7. The beginning of basic research at individual spas. The work begun by the New York State Research Institute of the Saratoga Spa offers an example.

8. The well financed Baruch Committee on Physical Medicine. Among the many fine achievements of this committee is an allotment of \$250,000 to a teaching center for research in the field of hydrology, climatology and spa therapy. I can think of nothing more needed to put water therapy and spa therapy on a rational basis than the type of research proposed by this committee.

9. The determination on the part of the management of some of the spas to remain honest—to take advantage of their natural resources by assembling at the springs such equipment and trained personnel as are needed to give patients suffering from certain of the chronic diseases the best available treatment, but to avoid scrupulously methods of exploiting mineral waters in the manner too common in the past.

Comments and Conclusion

1. Any discussion of this subject at the present time cannot be pitched on a high scientific plane because, so far as I can find, until recently the methods of science have rarely been applied to its development or study.

2. Many mineral waters and the spas which are built around them have sufficient virtues to justify their use in therapy, but the waters are only accessories and not the whole thing.

3. Any type of therapy which has been the means of giving so much comfort to so many people through so many centuries in so many parts of the world cannot be ignored. If it is harmful, or even useless, it is up to physicians to protect their patients from it; if it has merit—as I believe it has—it is up to physicians to discover this and see to it that their patients are not deprived of its benefits.

4. And, finally, it is my belief that those who have at their disposal such a set of "tools" should use them wisely and only for such purposes as they are useful. In other words, let them do with these tools the things they can properly do and not pretend to do things they cannot properly do. Let them be honest and conservative in the use of these tools if for no other reason than to compensate for the lack of this practice, too common in days gone by. At the same time let them be alert for new knowledge and apply such knowledge in the treatment of patients who entrust themselves to their care, whether this leads to the extension of the field of usefulness of these tools or the giving up of practices long thought to be useful.

C. WESLER SCULL, Ph.D.

JENKENTOWN, PA.

The clinical influence of massage represents a summation of several physiologic components; certain of these are outlined in table 1. Reduced

TABLE 1. — *Influences of Massage.*

Organ or Tissues	Primary or Early Effects	Secondary or Late Effects
Vascular system	Release of histamine with acetylcholine Vasodilatation Vasodilatation (rabbit ear chamber)	Increased flow Increased platelets in red blood count Sticking of emigrating leukocytes Decreased pooling of blood in splanchnic area Discharge of red cells from spleen
Lymphatic system	Emptying	Decreased trend toward fibrosis
Striated muscle	Stimulation to contraction	Relaxation from spasm
Unstriated muscle	Stimulation to contraction	Discharge of materials
Nervous system —		
Deep nerve trunks	Stimulation	Reflex relaxation
Cutaneous sensory nerves	Stimulation	Relaxation of the psyche
Central nervous system	None	Relief of pain
Connective tissues	Friction between parts	Increased elaboration of lubricating fluid
Joints, synovial fluid	None	Increased rate of removal of particulate materials (egg albumin, india ink)
Ducts, channels (non-circulatory —		
Colon } Prostate } Tonsils }	Emptying, external	Decreased absorption of toxic materials
Lymph nodes } Pathologic nodules }	Emptying, internal	Accelerated resolution

to its simplest terms, massage involves the application of the stimulus of pressure to tissues.

Effects of Massage

Mechanical Displacements of Fluids. — The most obvious response is a direct physical influence on distribution of material in the vascular and lymphatic structures of tissues, in ducts and even in certain regions of the gastrointestinal tract. In any of these structures, application of external pressure would be expected to displace their contents, gaseous, fluid or semisolid, into regions subjected to lesser pressure.

Automassage. — Pressure of various degrees is normally exerted on all tissues of this kind during the course of physiologic activity. Rhythmic alteration of pressure is well evidenced in respiratory movements and in the automassage thereby exerted on the visceral organs. When the normal, or physiologic, stimuli are modified in disease, as in the case of ankylosis of the thoracic cage or decreased diaphragmatic excursion, secondary changes may ensue in the activities of adjacent viscera.

By the same token, normal skeletal muscular activity involves changes in

* Presented as Part of Instruction Course, Twenty-Third Annual Session of the American Congress of Physical Medicine, Cleveland, Sept. 6, 1944.

contour of muscle masses. These alterations in shape exert various degrees of pressure on blood and lymph vessels included within the muscular tissue. When muscular activity is reduced by disease or injury, automassage is diminished and return of fluids through the veins and lymph vessels is modified. Secondary effects of venous and lymphatic stasis might be expected to follow. Inactive tissues display a relative reduction in the passage of materials through such channels. This is largely compensatory and compatible with those essential functions which vascular channels support and lymphatic channels drain, but the secondary consequences may be disadvantageous. Thus, sustained stasis of lymph favors fibrosis. In order to prevent irreversible transformation of active tissue cells into inactive tissues, attempts at correction of lymphatic stasis are often indicated. Used to this end, therapeutic massage constitutes a replacement of automassage and in this sense may be regarded as substitution therapy. This view may appear incapable of full realization, as it would seem to require almost continuous application of external massage, which is impractical in most instances and might not be completely equivalent to automassage in any case. Some approximation can be achieved, however, wherein massage is carried out with regard to both anatomic arrangement and physiologic function of the parts. Most skeletal muscular activity is intermittent, not continuous; so, at least for the purposes of substitution therapy, massage at short intervals could achieve the purpose.

Removal of Toxic Materials. — In addition to direct mechanical displacement of fluid in vascular and lymphatic channels, massage is used to expedite removal of toxic or foreign materials from focal lesions. Dissolution of foreign or pathologic deposits by means of the direct influence of pressure, which induces an associated increase of blood flow, is likewise practiced.

Rhythmically alternating pressures are also therapeutically employed to discharge fluids from the lungs and initiate respiratory movements after drowning and asphyxia. Mechanical respirators and suction and pressure boots used to promote circulatory efficiency in limbs possessing inadequate blood supply likewise involve massage, although these agencies are not usually included under this heading. These several procedures depend on displacement of materials, gaseous or fluid, from certain areas by means of externally applied pressure and involve incidentally at least a summation of the physical influences which are associated with massage.

Neurovascular Effects. — Therapeutic massage achieves more than physical displacement of material within the vascular channels of tissues. Sensory and reflex nervous responses result from stimuli afforded by application of various pressures to cutaneous and muscular areas. Neurovascular adjustments secondary to direct pressure and movement of materials within tissues therefore assume considerable importance in the total response following massage.

The lightest form of massage consists of the light stroking of the skin known as effleurage. The direct physical effects of this measure are probably relatively slight. The larger vascular and lymphatic channels are not directly influenced. While the finer superficial channels are both directly and indirectly affected, it appears probable that sensory and nervous influences are also important. Effleurage provides rhythmic stimuli to the organs of touch which may be registered centrally in various ways, one of which is vaguely comforting and conveys a sense of content.

Application of greater pressures increases both the direct mechanical influences and the direct nervous stimuli. A strong stroke over the skin of the forearm, for example, may be seen to produce blanching, followed by hyperemia. A comparable response is seen in therapeutic application of deeper massage. This effect may be intermediated by release of histamine and/or acetylcholine

from the tissue under the influence of mechanical pressure or partly by the brief temporary anoxemia from lack of blood in the compressed area. In view of the release of acetylcholine in the transmission of nervous impulses, it is not unlikely that this plays an intermediate role in the vasodilatation connected with massage. The response in any event is a dilatation of the cutaneous vessels with increased volume of blood flow. The principal effect may be primarily local if the area is small. If the cutaneous area involved is large, probably comparatively large and massive shifts in blood distribution may be brought about. Such massive redistribution of blood might involve removal of blood otherwise stagnating within the splanchnic or other areas.

Neuromuscular Effects. — In addition to neurovascular responses, massage may induce significant neuromuscular activity. Whether this is effected as a result of direct stimulus to muscles or is secondary to neurovascular response is not certain. Among arthritic patients neuromuscular disturbances, such as twitching and spasm, are not uncommon and massage affords significant relief of these symptoms.

Metabolic and Biochemical Effects. — General metabolic and biochemical effects of massage obviously are determined by its locale and general magnitude. Furthermore, the influence of repeated massage may be cumulative, and it is not always possible in short time experiments to secure objective data commensurate with apparent clinical results. However, there are significant data on the general influence of massage on certain metabolic processes.

Cajori, Crouder and Pemberton, showed that general body massage does not importantly elevate the consumption of oxygen above the basal resting level. Cuthbertson likewise observed neither an immediate nor a delayed effect of massage on oxygen consumption, pulse rate or blood pressure in normal subjects. It may be inferred, then, that the stimulation afforded by massage, in contrast to exercise, does not involve significant increments of energy loss by the body. The same investigators have also demonstrated that massage is not followed by significant modifications in urinary output of acids or of bases. Furthermore, there is no elevation in the level of lactic acid in the blood. The absence of alterations in composition of blood and urine is in marked contrast to the changes associated with active exercise. After exercise there is increased organic acid in the blood, secondary to muscular contraction; a corresponding decrease in plasma bicarbonate, and an increased output of acid in the urine. In short, there is acidosis. The absence of changes in the composition of the blood after massage contrasts with the sweating, overventilation, loss of carbon dioxide and other acids and consequent relative alkalosis induced by prolonged systemic exposure to heat (table 2). That there is no shift in en-

TABLE 2. — *Metabolic Responses Following Massage, Heat and Exercise.*

Metabolic Response	— Change After Application of — Physiotherapeutic Agent		
	Heat	Exercise	Massage
Hydrogen ion concentration (pH) —			
Urine	+0.6	—	None
Blood	+0.26	— 0.14	None
Carbon dioxide capacity of blood (volume per cent).....	+5	—15	None
Lactic acid of blood (mg. per 100 cc.).....	None	+65	None
Oxygen consumption	+	+	None

ergy output or in acid-base equilibrium after massage does not indicate, however, that it exercises no physiologic influence. One conspicuous response to massage is diuresis with an increase in the rate of excretion of total nitrogen, inorganic phosphorus and sodium chloride as compared with the rate in control periods. In contrast to the results observed in normal subjects and in arthritic

patients, Cuthbertson noted that in patients convalescing from fractures of the long bones, local massage enhanced significantly the retention of nitrogen, sulfur and phosphorus necessary to tissue repair.

Circulatory Effects. — Definite peripheral vasodilatation together with an increase in the rate of peripheral blood flow occurs with general massage. This change is induced, however, without perceptible alteration in the oxygen saturation of venous blood, a fact indicating that there is no heightened rate of general circulation, as after exposure to heat. The most conspicuous result of general massage is recognized grossly by redness and increased temperature of the skin. This is microscopically evident by an increase in the number and caliber of the cutaneous blood vessels visible under low power magnification. Carrier has presented evidence to suggest that the influence of mechanical stimuli on opening capillaries is not necessarily, intermediated by activities of sensory nerves. The contrast with the resting unstimulated state is particularly well marked in patients with the reduced peripheral blood flow often observed among those with chronic arthritis. Mitchell showed forty years ago that general massage increased the blood count, especially in persons with anemia. This observation has been essentially confirmed by Pemberton and myself on normal and arthritic persons. Lucia and Richard noted an increment of blood platelets after massage. Schneider and Havens found that abdominal massage induces an increase in red cells at low altitudes, whereas after acclimatization at high altitudes this response is not produced. McMaster demonstrated that massage accelerates the flow of lymph. Drinker and Field likewise noted this influence of massage on the lymphatic channels. Bauer, Short and Bennett noted an acceleration in the rate of removal of foreign material injected into joints by massage applied to adjacent muscles.

An additional feature of the physiologic response to massage has been revealed by Clark in observations on capillary circulation in the rabbit's ear. Following stimuli comparable to massage, there is not only an increase in the rate of blood flow but also "sticking" of leukocytes to the capillary walls and emigration through these walls. While this response may reflect microtraumatic factors, these very factors may promote exchange of materials between the vascular and extravascular spaces. Enhanced availability of leukocytes may be included, therefore, among the consequences of massage.

Technic of Massage

Adjustment of Dosage. — The technic of massage must be nicely adjusted to its intended purpose. The net result of administering massage may be made qualitatively different by extreme variations of dosage. The situation is comparable to that of certain active pharmacologic agents, useful in small doses and deleterious in larger amounts. Furthermore, some patients exhibit unusual sensitivity to comparatively small doses, responding unfavorably even to moderate application, and hence blanket prescription of massage is rarely justifiable. Prescribing massage of undefined magnitude at arbitrary intervals, such as three times weekly, to patients who present rheumatic or other complaints is not practical and may be harmful.

Determination of the response of the patient and coordination of the dosage with all other measures used are essential. In principle, the physician alone is in a position to evaluate the situation as a whole and should no more delegate this responsibility to the masseur than he would delegate prescription of the dosage of, say, thyroid extract to a pharmacist. Because the principles and practice of massage have not been taught to physicians, however, properly trained physical therapy technicians have a longer and wider perspective of the field as a whole than have most physicians and are usually competent to administer

a conservative kind and amount of massage if acquainted with the individual situation and the given desiderata. Great harm may be done, however, by over-treatment or by any treatment in the presence of certain contraindications, which the physician alone can evaluate.

Of the several schools of manipulation, or massage, the best known is perhaps the Swedish, distinguished by emphasis on one or more variations of technique, whose details must be sought in manuals devoted to the subject. On the basis of the physical and physiologic effects, light stroking and deep stroking are perhaps more widely applicable than other varieties.

Effleurage. — The direct effects of light stroking, effleurage, probably are limited to the skin and are concerned largely with stimulation of reflex influences. The procedure consists of slow, gentle and rhythmic minimal pressure exerted by the hand over a given area; hardly more, indeed, than the light stroking of a caress. Each stroke is usually rather slow and long and during any one period is essentially uniform in speed. A rate of about ten strokes per minute is commonly used. For a subject of nervous temperament a slower pace is indicated. The essential attributes of this form of massage are the lightness of pressure used and the rhythmic pace of the stroke.

While the apparent influences of effleurage are moderate in extent, the net results include a reflex relaxation by mild stimulation of the cutaneous sensory nerves, together with a significant influence on capillaries and lymphatic vessels of the skin. Effleurage not only is used as a single agency but is frequently employed as an introductory procedure to more vigorous varieties of manipulation.

Deep Stroking. — Deep stroking includes additional effects, viz., mechanical influences on the larger and deeper vascular and lymphatic vessels of the skin and underlying structures. Pressure is exerted chiefly through the palmar surface of the hand so that pinching or bruising is avoided. In response to this stimulation, a protective reflex action of muscles may arise to negate the intended result and even exacerbate such general tension or muscle spasm as may already be present. Hence it is essential to secure relaxation and to apply the massage to avoid marked compensatory activity of this kind. The patient should be in the recumbent position. The direction of deep stroking usually is toward the heart, to afford assistance to the venous return and to the flow of lymph. A fixed rhythmic application is desirable in this type of massage as well as effleurage.

Percussive Massage. — Massage can be applied in other ways, as by light hitting or tapping of the part concerned. In marked contrast to long horizontal stroking along a line, a form of "percussion" may be used, known as "tapotement," which involves a "hacking with the ulnar side of the hand or "clapping" with the palm. Here intermittent pressure over a succession of small areas, instead of continuously changing pressure along a line, is applied. Tapping by the ends of the fingers is used occasionally. Percussive procedures are used principally after exercise and less often in the treatment of debilitating disorders. Mechanical vibrators produce comparable effects but may induce trauma and lack the adaptive conformity to the needs of the moment which the trained hand and the *tactus eruditus* achieve.

Compressive Massage. — Compressive effects of massage are used more frequently than are those of percussion. Two procedures involving "compression" are employed, "kneading" and "petrissage." Both involve essentially a rolling sequence of pressures over a succession of small circular areas. Pressure is exerted by the palm and by the "ball" of the fingers, never by the ends of the fingers. This precaution, by virtue of the cushioning effect of joint motion, minimizes the possibility of exerting traumatizing pressures. The circular

motion is determined by the extent of movement of the skin over the underlying structures.

"Petrissage" differs from simple kneading only in that it is applied by holding the part in one hand while applying the kneading movement with the palm of the other. The squeezing of tissues by compressive procedures involves several physiologic effects. There is not only the sensory stimulation from pressure but also a direct mechanical influence on the muscles, connective tissues and blood and lymph vessels. In contrast to the long stroking motion suitable for general drainage of a leg or arm, desirable influences can be secured within lesser tissue masses by kneading. Sensory stimuli as well as reflex vasodilatation of vessels in the tissues compressed are likewise involved.

Petrissage provides a reasonably well controlled mechanical means of breaking up certain pathologic accumulations in muscular or cutaneous regions. Furthermore, it expedites passage of such liberated material into vascular or lymphatic channels dilated by reflex response to the same stimulus.

"General body massage," beginning with the extremities and including the abdomen and back, involves a summation of the effects secured in these several regions and achieves the maximal influence of the massage process. General body massage conveys benefits, quite apart from effects of purely local treatment. These benefits are seen in the heightened blood count, improved color, increased appetite, added sense of energy and general sense of *bien-aise* which follows a course of massage. These effects may be valuable not only in ill health but also in preserving and improving the balance of health in later decades of life when systemic exercise is contraindicated or otherwise precluded.

Mild kneading sometimes is applied over the colon, starting with the lower part of the descending, continuing with the transverse and concluding with the ascending colon, the motions proceeding always distally. The purpose is to stimulate emptying of the viscus not only by direct mechanical influences but by the combined influence of increased blood flow and reflex muscular activity induced by pressure over the organ. While directed chiefly toward the colon, other visceral organs are influenced both directly and indirectly.

Other Types of Massage. — Methods employed for special purposes include "cupping," whereby the tissues are elevated, or pulled up, by negative pressure or suction into a cup. The adaptor, into which the elevated tissue mass is drawn, may be moved along the skin surface, lubricated by mineral oil or petrolatum, thus producing an effect somewhat comparable to that secured by stroking. Another mechanically operated variety of massage is afforded by a vibrating strap or belt applied with sufficient pressure to prevent its slipping over the skin surface. This involves internal friction, with its attendant reflex vasodilatation of blood vessels, the net effect of which is a kneading of the underlying tissues. These mechanical substitutes for massage are undesirable in general and may be dangerous.

Certain other procedures, generally classified under the heading of hydrotherapeutic measures, involve massage. So-called "pressure douches," wherein a stream of water under pressure is played on the subject, afford a combination of "microhacking" and the effect depending on the direction of the stream, kneading or deep stroking. Rhythmic sensory stimulation, as well as direct physical and physiologic influences, characterizes all these procedures.

Application of Heat with Massage. — Apart from such procedures as the Brand bath, and the frequent use of ice in cooling of tissues for a period of hours immediately after trauma, the value of each of the several measures discussed usually is enhanced by prior exposure to heat. The method of employing heat is determined by convenience. Heated materials, water bottles, warm towels, radiation from incandescent lamps, resistance coils or diathermy may

be used. There is no practical difference between the results of the several methods except as to penetration. Heated tissues generally are more relaxed, and the peripheral vessels are dilated as compared with the unheated tissues. Both conditions favor maximum benefit from the subsequent application of massage.

Under certain circumstances, particularly in conjunction with efforts to restore or preserve muscular function, brief limited and voluntary muscular activity also is indicated. When voluntary muscular activity is impossible, the galvanic or faradic current may be used to stimulate activity. This kind of exercise should ordinarily follow a brief period of massage and in turn be followed by a period of massage.

Clinical Results

The physiologic effects of massage make it evident that its use is not confined to any single disease. Certain states of systemic or local fatigue are amenable to massage. Thus its value in expediting recovery after exercise is widely appreciated by trainers and athletes. The oxygen debt and the accumulation of catabolites are liquidated by muscular relaxation and vasodilatation induced by massage. Analogously, faulty muscular metabolism, including the accumulation of waste products incidental to debilitating disease of many kinds, may be benefited by cautious and skilful massage. One symptom of such chronic states is a sense of general fatigue, which may be relieved at times by general massage, through removal of waste products and additional availability of blood elements.

Fatigue. — Following Weir Mitchell, neurologists have long utilized massage for its tonic and sedative influences in the so-called rest cure. The sedative effect can also be utilized in the treatment of insomnia and to calm the hysterical patient. The subjective sense of relief and security afforded by rhythmically repeated peripheral stimulation may be of contributory value in these several conditions. Both neurasthenia and the neurasthenic features that complicate chronic disorders, particularly chronic arthritis, may be significantly helped by massage.

Muscular Pain. — Muscular spasm or tension arising as a feature of myalgia and fibrositis and as a secondary feature of chronic arthritis is greatly benefited by massage. Incidentally, muscular inflammation may be differentiated from irritation of a nerve by the firm muscular tremor produced in response to pressure in the case of muscular disorder, which contrasts with the general reflex response from the same stimulus in the case of involvement of a nerve. Lumbago, acute wryneck, and muscular discomfort associated with acute infections are almost always benefited by stroking and kneading adjacent to or over affected regions. Symptomatic relief often can be afforded similarly in neuritis and neuralgia. Overstimulation is to be avoided in the case of any of these conditions.

Local Lesions. — Muscles and Joints: In addition to relief of fatigue and pain, compressive or deep massage is advocated to disintegrate and dislodge painful nodules sometimes present in fibrositis and atrophic, or rheumatoid, arthritis. While the objective is clear, caution must be exercised in applying this measure, because dissemination of material of unknown nature, possibly infectious, may have detrimental consequences.

Massage to tissues in the region of joints in experimental animals may accelerate removal of india ink and proteins introduced into the joints, as demonstrated by Bauer. This indicates the probable accessibility to massage of pathologic accumulations of fluids, within joints, of either transudative or exudative nature. The influence is an indirect one, largely referable to improvement of

lymphatic drainage from the affected areas afforded by deep stroking. The principal application of such massage should be over the muscle masses activating the joints and thus indirectly to the lymphatic structure draining them. Active courses of massage are not recommended during periods of acute inflammatory reaction. Acutely inflamed tissues of traumatic arthritis and bursitis are usually immobilized until the inflammation subsides. Forceful manipulation of the joint during massage is always contraindicated.

Tonsils: Repeated therapeutic compression of organs such as the tonsils and prostate gland for the expression of infectious accumulations affords a conservative and often effective means of dealing with infection in these regions. In the presence of some systematic diseases, such as chronic arthritis, extrusion of toxic or infectious material by massage may give rise to systemic effects because of the breaking down of some of the walls of defense erected by nature.

Gums: Prophylactic or therapeutic massage of gum tissues is often followed by general improvement in nutrition and is therefore valuable in the prevention or correction of gingivitis.

Peripheral Edema. — Peripheral dependent edema can be greatly diminished or removed by skilful massage, whose principal purpose is acceleration of lymphatic flow and return of fluid to the vascular system, where it can be made available to the kidneys for excretion. Relaxed and atrophic tissues of chronically disabled patients often are the site of tissue edema or lymphatic stasis, not always grossly apparent, due to loss of muscular activity and tonus which normally support or activate the passage of lymph through these channels. Thus, massage often is indicated for either bedridden patients or those afflicted by loss of active muscular tissue as substitutional therapy for active exercise. Massage is almost a specific in relieving the tenderness of the pretibial and calf regions frequently accompanying arthritis, as in correcting circulatory disorders in the limbs, such as Raynaud's disease, intermittent claudication and acroparesthesia. In the case of circulatory disorders, care must be exercised against dislodgment of clots, liberation of emboli or, in phlebitis, irritation of the inflamed vessels. Caution must also be exercised when local areas of infection are present in order to avoid dissemination of infectious agents. There is danger of releasing into the circulation systemically toxic materials from the tissues of chronic arthritis, especially in the elderly. Even light massage in such patients may, unless carefully controlled, give rise to systemic reactions accompanied by fever.

Trauma. — When traumatized areas, after sprains or fractures, are immobilized, effleurage and light stroking are valuable in promoting healing, partly by reducing to a minimum the undesirable effects of stasis in the immobilized members, which are handicapped nutritionally. Effleurage and light stroking promote absorption and removal of detritus of extravasated blood and serum in the muscular and cutaneous areas, both by virtue of direct influences and by reflex relaxation of the tensed structures. Deeper treatment likewise promotes relief of lymphedema and, together with reflex responses, augments the flow of blood in the area concerned. Early institution of massage not only assists materially in decreasing pain but accelerates the rate of functional recovery. This is widely appreciated by large industrial firms, which depend on it to decrease the incidence of permanent damage, hasten convalescence and reduce premiums paid for insurance. According to the relative risk of moving fractured parts, light stroking may be instituted almost immediately after an injury, proceeding gradually through effleurage to deeper and more vigorous massage.

Conservatively administered massage has a definite though limited place in

the treatment of muscles affected by anterior poliomyelitis, peripheral nerve injury, hemiplegia and spastic paralysis.

General Effects. — In addition to the local influence of massage, generalized application achieves not only larger quantitative results but even what appear to be qualitatively different effects. Diuresis can be induced by a general body massage. The peripheral blood count can be elevated by abdominal massage. In the aged and in chronically disabled persons, general massage can compensate for certain secondary consequences of inactivity. Guarded and skilful massage is regularly utilized to combat circulatory collapse and shock.

Claims for the "fat-dissolving" effects of massage, particularly of the instrumental variety, appear to be greatly exaggerated. Massage is of great value to atrophic muscles by promoting a return toward physiologic balance, but it will not induce development or hypertrophy, which can be achieved normally only by active exercise. Massage has value in the treatment of neurotrophic muscular disorders and those arising from inactivity, in that it encourages voluntary muscular activity because of the improved circulation induced.

The cosmetic effects of local massage are often overemphasized, but that local massage may give rise to an improved physiologic balance in the facial tissues can hardly be doubted, especially when it is employed in conjunction with a program directed toward the body as a whole.

General Considerations. — Overvigorous application of any physical agent may give rise to unfavorable results, and careful control is essential in administering. Like the prescription of rest, the prescription of massage should be made with respect to specifically desired effects and not as an ill defined blanket recommendation. Effective application of massage is so dependent on physical relaxation that rest may be regarded as a component part of massage in practice. As one of the purposes of massage is to direct the flow of blood to certain regions in amounts exceeding those required for immediate metabolic demands, opportunity must be allowed for blood so directed to achieve its intended functions. Obviously, to permit the subject of general massage to resume activity at once and thereby increase the rate of production of catabolites and the rate of oxygen consumption is to defeat the original purpose of treatment.

For the purposes indicated, however, massage provides an indispensable agency in control of significant features of many disease processes, including such diverse syndromes as poliomyelitis; anemia; arthritis; traumatic injuries, especially to joints; circulatory disorders, such as acroparesthesia, Raynaud's disease, intermittent claudication and cardiac edema; chronic inactivity, particularly that of the elderly; neurasthenia, and other nervous conditions.

No drugs can accomplish the purposes of massage, nor can drugs, in general, be localized in their effects and directed with equal refinement to the particular parts concerned. The nucleus of physical therapy as a whole is the quartet of rest, heat, massage and exercise, and to these nothing has been added in principle since the days of the ancients, except irradiation involving roentgen rays and radium. "Laying on of hands" unfortunately has fallen into the wrong hands in many instances, but the renaissance now taking place in physical therapy promises that this oldest of healing arts will again come into its own.

Optimal effects from the application of massage can be secured only when this procedure is prescribed as an element of a well integrated therapeutic regimen and when it is administered with the technical skill of one familiar with the anatomic and physiologic features of the regions treated as well as the pathologic processes to which they are subject.

ELECTRIC SHOCK THERAPY OF THE PSYCHOSES *

SAMUEL H. RUSKIN, M.D.

DETROIT

While shock treatment has evoked a great deal of interest in the past few years as something new in the treatment of mental illness, it is really not new, but only a resurrection of methods devised to bring about a change in the disordered personality and restore it to normal psychologic activity.

At present we look with horror and apprehension on the older forms of shock treatment, by which patients were treated in the most barbaric manner. A patient might be rotated in a chair and suddenly let down into a well or a pit full of snakes, or actual violence might be used, including suffocation.

During the past two centuries electricity was popular in the treatment of mental disorders. In the middle of the nineteenth century it became so popular that Huff remarked that mental illness should not be considered incurable until electricity in one of its forms had been tried. Sir Clifford Albutt in 1872 made a systematic study of the use of electricity in the treatment of mental disorders. He used a continuous current applied to the patient's head for ten minutes each day. Evidence of sympathetic stimulation, such as "flushing of the face, giddiness, increased pulse rate and dilatation of the pupils," was noted in most cases. He observed marked improvement in acute primary dementia, distinct improvement to a lesser degree in mania and recent secondary dementia, no change in chronic dementia and brain wasting and unfavorable results in hypochondriac melancholia.

With the introduction of various types of shock produced by different chemical substances, Bini in 1937 suggested that electricity could be used as a physical means of producing epileptic attacks in place of chemical substances. By the passage of "street current" (120 volts) for a very short time (one-twentieth to one-fifteenth second) through the body of a dog, one electrode being placed in the mouth and the other in the rectum, he was able to produce typical epileptiform seizures. The animal lost consciousness for one to two minutes. Bini described widespread and severe alterations in the nervous system and concluded by stating, "The alteration met with in animals does not permit us to exclude the possibility of these physical methods in human therapy, and that the changes may be responsible for the favorable transformation of the morbid psychic picture of schizophrenia." Cerletti and Bini had the courage to shock a number of patients into convulsive seizures and unconsciousness, using from 300 to 600 milliamperes and 80 to 115 volts for from five-tenths to seven-tenths second. They reported results as good as those obtained from pharmacologic shocks. A current of such high milliamperage and low frequency is apt to produce severe changes in the central nervous system.

The apparatus in use at the present time has been simplified since the one originally developed by Cerletti and Bini to the extent that owing to the present war emergency a standard type of sinusoidal shock apparatus has now dispensed with meters. The physician determines just what strength of current he will use and sets the dial accordingly. The patient is then placed in the circuit, and with the test switch in contact another dial is turned until two lights on the apparatus light up with the same intensity, which shows that the current is at the proper adjustment. The apparatus

* Read at the Midwestern Sectional Meeting of the American Congress of Physical Therapy, Detroit, May 31, 1944.

also has a safety switch so that if a stronger current than that intended starts to go through into the patient's circuit, a switch is automatically disconnected, and the treatment interrupted. The time can be adjusted from one-tenth to one second. Usually the treatments are started at from three-tenths to five-tenths second, 400 milliamperes being used. If a convulsion is not obtained, both the length of time and the strength of current may be increased until convulsion is obtained.

On several occasions a latent period of thirty-five to forty seconds has occurred before the convulsion has set in. If there is no convulsion there is usually a loss of consciousness lasting from two to ten seconds, which is followed by confusion with retrograde amnesia for all events prior to the treatment. Often the patient will even forget the name of the hospital or the name of the physician. There are always an immediate flushing of the face, loss of reflexes and a positive Babinski reaction, showing a marked influence on the motor cortex. There is noticeable also, especially when a subconvulsive dose is given, pronounced dysarthria, which indicates an interference with the motor speech area. Often if the desired convulsion is not produced, it may be obtained by giving two electric shocks in quick succession or else by prolonging the length of time of the shocks. Some authors have claimed that the time factor is not important. It has been found that by lengthening the time a convulsion can often be obtained with a lower voltage. The convulsion following electric shock is similar to that obtained with metrazol. It is divided into the usual tonic and clonic stages, with attendant symptoms. The primary tonic stage as seen in the metrazol convulsion is usually greatly diminished. The usual cry noted in the metrazol convulsion occurs infrequently, but it has been noted occasionally preceding the convulsion. The convulsions in this form of therapy are usually less severe than those produced with metrazol. The cyanosis is not as marked.

Although the use of shock treatment is increasing, differences of opinion still exist as to why it is effective. The theories advanced by Sakel have been criticized by Cobb and Gellhorn. A review of Sakel's monograph recently published stated, "The clinician will profit from reading the monograph provided he ignores the theoretical and considers only the factual part of the exposition."¹ The theories advanced by Meduna have been attacked by Harris and others.

Gellhorn offered a theory that insulin, metrazol and other drugs used in pharmacologic shock therapy benefit the patient by producing anoxia which stimulates the autonomic nervous system in the hypothalamus. Friedman speaks of shock therapy as an irritative therapy which stimulates the central nervous system and breaks up "physiologic barriers" to certain associative pathways. Bennet suggested that the effects on depressive conditions are probably due to the efforts of the patient to prove to himself his willingness to undergo punishment, with a subsequent resolution of his guilty feeling. Some believe that the shock treatment increases the metabolism in the brain by a sudden rise of the systemic blood pressure. It has been suggested by Querido and Van der Speck that shock treatment does not make patients more social but merely more submissive. Many workers maintain that fear alone is the main effective element. They speak of the patient's fear of the shock treatment as a fear of death or a "threat of extinction." The frequent observation that the psychotic patient temporarily loses his psychotic symptoms or improves when his life is threatened by an acute

1. Sakel, M.: *Pharmacological Shock Treatment of Schizophrenia*, authorized translation by J. Wortis in *Nervous and Mental Disease Monograph Series*, No. 62, New York and Washington, Nervous and Mental Disease Publishing Co., 1938.

infectious illness or when he is subjected to a sudden emotional shock or a major surgical operation supports this theory.

In contradistinction to older medical views that a dichotomy of the mind and body existed, it is now generally agreed that there is a psychosomatic interrelationship between psychologic and bodily functions through the medium of the autonomic nervous system. When an individual is unable to face the realities of life, emotional conflicts develop. These conflicts interfere with intricate adjustments necessary in life, and the lower and automatic centers of control then assert themselves. Consequently the individual no longer has a harmonious and fully integrated behavior. A vicious circle becomes established, and uncontrolled psychic reflexes tend to accentuate and prolong the newly acquired abnormal mental behavior. During the acute stage little can be done through the customary psychotherapeutic approach, since the patient is often mute, unwilling or unable to cooperate. After the acute stage passes it is often too late to accomplish much by pleading with reason, for the patient has drifted into a reconstructed world and is no longer able to cope intelligently with his daily problems. Cannon stressed the futility of trying to argue patients out of their emotional reactions, since the cortex has no direct control over the autonomic nervous system. For this reason interviews, explanatory talks and reassurances are usually found to be inadequate.

Gellhorn has pointed out that pharmacologic shock treatments act as a powerful stimulation to the autonomic nervous system. This is obviously true also of the different types of electric shock therapy. Henry said that the autonomic system elaborates the current feeling by a reflex mechanism whether a person is responding to external danger or to internal conflict. According to Singer the presence of a psychosis always indicates a disturbance in this system. Therefore it appears that shock therapy through autonomic stimulation in some way dislodges hallucinations, delusions and other symptoms disturbing to the patient which occur in psychoses. The exact process by which this takes place remains obscure. Probably different factors operate in different cases, depending on the individual reaction type. In some cases shock therapy may act as a planned fear reaction which interrupts abnormally established thought habits and permits a reorganization and readjustment of a more normal thought flow. Or the action of shock therapy may in a broad sense be likened to a form of counterirritation. Undesirable habit thought patterns are forcefully replaced by a real and visible threat to the organism, and through activation and motivation the patient is brought back to face realities. Some depressed patients may experience relief from a feeling of guilt through their willingness to submit to shock therapy, which they regard as a punishment. Other patients may summon all of their resources to face reality in order to avoid further treatment.

Comparison of the Current Forms of Shock Treatment

I believe that all forms of pharmacologic and electric shock therapy produce similar effects, since all are psychophysiologic methods. Two conditions are known to occur: (1) powerful stimulation of the autonomic nervous system, followed by (2) depression or temporary inhibition of the higher cerebral centers. Increased pulse rate, elevation of the blood pressure, dilatation of the pupils, flushing of the skin and increased salivation are some of the evidences of stimulation of the autonomic nervous system. After this stimulation the higher centers are depressed or temporarily paralyzed by the resulting coma or unconsciousness.

In a search for a safe and better controlled substitute for pharmacologic

and electric-convulsive shock therapies, Berkwitz devised a method which he believes can produce similar effects by safer means. For stimulation, a faradic current well within the margins of safety is used in place of drugs. This current is not strong enough to produce convulsions or irreversible physiologic changes. Immediately after a brief series of electric shocks applied to the patient's head, pentothal sodium is administered intravenously for a quick anesthesia. With noncommunicative and stuporous patients, additional information regarding their condition may be obtained by using a subanesthetic dose of sodium amytal administered intravenously instead of pentothal sodium. With either drug the higher centers are temporarily inhibited and the patient is left in a relaxed condition which is obtained under better control than is possible with the other shock methods. An immediate improvement may be obtained in stuporous and noncommunicative patients with sodium amytal alone, but this change is very temporary.

With all methods it appears that best results are obtained when the personality is acutely and more or less totally involved and when the psychotic symptoms are decidedly unpleasant to the patient. In so-called catatonic and paranoid types of schizophrenia, the results are far superior to those obtained in the simple and hebephrenic types. In the more chronic forms an adjustment is usually made at a lower level of mental activity. After six months to two years it appears that the psychotic symptoms become less disagreeable to the patient, and consequently they are less likely to respond to shock therapy. In the affective disorders the depressed types respond far better to shock therapy than the hypomanic and manic types, for the latter usually retain a keen awareness of their position and environment and have fewer unpleasant symptoms which annoy them. The most dramatic results are obtained in acute hysteria, for recovery usually takes place with the first treatment with convulsive or faradic therapy. The chronic forms of psychoneurosis are not greatly benefited by shock therapy. In these conditions the personality is partially involved over a long period, and the patient has been in the habit of making only a partial adjustment. Temporary results are obtained with the first few shock treatments, but lasting results can hardly be expected, since most of the patients do not want to get well emotionally, though they may want to intellectually.

The relative efficacy of the different types of shock therapy remains to be established. Since mental disorders are not definite entities and in each case many complicating conditions exist, this question will not be answered until extensive statistical studies of the different methods are carried on over a considerable period. More rapid response is noted with metrazol, electric-convulsive and faradic shock than with insulin-hypoglycemic shock. Improvement is usually noted within the first five treatments, whereas with insulin-hypoglycemic shock the response is more gradual and a longer series of treatments is usually required. Some workers have found that catatonic excited and paranoid types react more favorably to insulin, while stuporous patients respond best to metrazol. Others believe that results with metrazol closely parallel those with insulin. They recommend that metrazol treatment be given first, since it is less expensive, requiring less time to administer. Some recommend combining or alternating these methods. Berkowitz believes that the least drastic method (such as faradic shock) should be tried first. If the results are not favorable other methods may then be used.

The type of psychosis that responds best to electric shock is that in which there is an element of guilt with depression. Of course, the shorter the duration of the illness, the more acute the onset and the younger the patient,

the better is the prognosis, especially in the schizophrenic reaction type of mental illness; therefore, the catatonic patient with feelings of guilt responds most favorably. Paranoid schizophrenic and hebephrenic patients do not do well at all. Involutional melancholia responds readily, especially when there is agitation with little paranoid ideation.

The age of the patient should be no contraindication for the treatment, as there are records of patients as old as 80 who have been treated successfully with electric shock. The family, of course, should be advised of the added risk. Cardiac conditions, while necessarily adding to the risk of the treatments, are not necessarily a contraindication, as numerous patients with a history of coronary diseases have been treated without any particular strain on the heart.

The complications seen in 312 cases observed at the Pennsylvania Hospital for Mental and Nervous Diseases consisted of fractures, dislocations, respiratory and vasomotor collapse, subconjunctival, hemorrhages and memory defects. One death occurred. I personally do not consider a memory defect as a complication, as all patients show this and it usually disappears after the treatments are stopped.

The fractures varied from slight compression fracture of a thoracic vertebra to fracture of the humerus. Dislocations of the jaw was frequent but is of no consequence. Cardiac complications occurred in 1 per cent of the patients; those affected were older patients. They responded readily to rest and medication.

The patient who died was 50 years of age and had been partially curarized by "intocostin."

All forms of shock treatment should be considered merely as an adjunct to psychotherapy. Other forms of psychotherapy are essential. Shock treatment may relieve the patient of acute psychotic symptoms, but it does not materially alter his constitutional makeup. It is therefore understandable that relapses occur among patients who have had remissions through shock therapy, as well as among those who have had spontaneous remission. It has been found that many patients who have had a relapse after shock therapy respond to further treatment. When remissions are brought about by shock therapy the ultimate prognosis may be more favorable, since terminating the psychosis abruptly through a specific means affords a better opportunity to explain to the patient how his mental illness came about and to point out how recurrences may be avoided.

Summary

Shock treatment is not a new form of therapy, but has been revised by the use of electric shock.

Electric shock is the most easily administered shock therapy, with the least cost.

The results of electric shock are comparable to those of insulin and metrazol shock.

Electric shock will alter only the existing mental state; it will not change the prepsychotic personality. Other forms of psychotherapy are essential.

1306 Eaton Tower.

ARCHIVES of PHYSICAL MEDICINE

OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL MEDICINE

.. EDITORIALS ..

APPLIED PHYSICS AND ITS ROLE IN MODERN MEDICINE

To many practicing physicians the word physics, is associated either with a course taken with little or no relish many years ago in the premedic curriculum in college, or with professors who deal with relativity, atom smashing, electronics and the like. Few think of physics as having real importance in their everyday professional work of diagnosing disease and treating patients. There is good reason to believe that college courses in physics for premedic students should be revamped so as to secure the interest of the student and induce him not only to learn the basic facts and theories of general physics but also to adopt the logical and analytical approach to natural phenomena which is characteristic of the physicist. Such habits of thought will be most valuable to him in his later career in medicine.

But aside from the value of physics in the training of a physician, its importance as an applied science in medicine has been increasing rapidly. The applications are important both in the diagnosis of disease and in the use of therapeutic agents. Many valuable diagnostic instruments have resulted from the application of physics and technology in medicine; the electrocardiograph is an example which might be mentioned. There can be no doubt that recent advances in electronics will bring forth new diagnostic instruments of use not only to the specialist but to the general practitioner as well.

While the value of certain therapeutic technics employed in physical medicine has been clearly demonstrated, many of the procedures are still highly empirical in nature. Illustrative of this is the use of high frequency fields in diathermic treatment. The biological effect of diathermy is a function of the field strength in any region. However, as a matter of fact, little is known about the field strength in the tissues subjected to the treatment. Instruments have been described by which the field strength may be measured but as yet they have not been employed to ensure the most efficient application of diathermic treatment. The fact that more than 50,000 diathermy instruments are currently in use in this country emphasizes the importance of placing this type of therapy on a sound physical as well as physiological basis.

To consolidate the advances which have been made in physical medicine it is urgent that research be stimulated and that promising young men be thoroughly trained for careers in this field. Great stimulation has been given to this program recently through the financial assistance of Mr. Bernard Baruch. The Baruch Committee on Physical Medicine has devised well

* From the Department of Biology and Biological Engineering, Massachusetts Institute of Technology, Cambridge, Mass.

conceived plans for accelerating progress in the field and has already put them into operation. An important aspect of these plans is the establishment of Baruch Fellowships by which promising young men may receive several years of special training both in basic science and in clinical work.

To give Baruch Fellows a good background in physics and technology as applied in medicine, the Baruch Committee has provided a center for the purpose at the Massachusetts Institute of Technology. In the Department of Biology and Biological Engineering at the Institute, Baruch Fellows may spend three to six months of concentrated study. Included in the course of study will be lectures and practical laboratory work dealing with the physics of heat, light, sound, electronics, short waves, x-rays, and radioactive materials as applied in medicine. Fellows will share in the compilation of a guide to the literature of instrumentation and to commercial sources of instruments. Opportunity will be given for research by specially qualified Fellows. The new center will cooperate with existing agencies of the American Medical Association and others in advising and cooperating with individuals interested in the development of new methods and instruments of use in Physical Medicine. After completing the course the Fellows will have a better knowledge not only of instrumentation but also of the way in which physics may be applied in all aspects of medical research and practice.

The field of biophysics is still in its infancy. The boundaries are still poorly defined. That it will play an increasingly important role in medicine cannot be doubted. Those interested in physical medicine have an opportunity not only to lay a firmer foundation for their specialty but also to stimulate in turn the development of biophysics. As biochemistry was greatly expanded by its close association with medicine so may biophysics be advanced. It is to be hoped that medical administrators will realize the opportunities that are now presenting themselves through the agency of physical medicine and that able men in medicine and in biophysics will cooperate to transform these possibilities into realities.

FRANCIS O. SCHMITT.



MEDICAL NEWS

New York Society of Physical Medicine

The New York Society of Physical Medicine has announced the following program for its meeting, March 6:

"The Mechanism of Pain with Special Reference to Headache," S. Philip Goodhart, M.D. (by invitation); "Therapy of Headache Including Its Psychosomatic Aspects," A. P. Friedman, M.D. (by invitation); "The Rôle of Allergy in Headache," Joseph Harkavy, M.D. (by invitation); "Headache—Ear, Nose and Throat Aspects," Alfred A. Schwartz, M.D. (by invitation). Discussion opened by Charles Brenner, M.D. (by invitation).

Charles F. Kettering Succeeds Dr. Anton J. Carlson

Charles F. Kettering was elected president of the American Association for the Advancement of Science, succeeding Dr. Anton J. Carlson, University of Chicago physiologist. Among vice-presidents named were Dr. Warfield Longcope, Johns Hopkins, medical science; Dr. F. D. Kern, Pennsylvania State College, zoology; Dr. A. I. Hallowell, Northwestern University, anthropology; Dr. Florence L. Goodenough, University of Minnesota, psychology, and Dr. Henry Eyring, Princeton, chemistry.

Physical Medicine at University of Kansas

Dr. Gordon M. Martin of the Mayo Foundation has been appointed to take charge of the new department of physical medicine at the University of Kansas. This department was organized on November 1 and will include the Department of Occupational Therapy as well as Physical Therapy.

The Mayo Memorial

A twelve story building will be constructed at the University of Minnesota Medical School, Minneapolis, to link existing units into one medical center as a permanent tribute to the late Drs. H. and William J. Mayo. Costing about \$2,000,000, the memorial will be on the medical school campus, serving as the main entrance to the school and the hospitals.

Aid to Handicapped

The United States Government Printing Office has just published Union Calendar No. 697, House Report No. 2077, entitled "Aid to the Physically Handicapped," a report of the subcommittee to

investigate aid to the physically handicapped of the committee on labor, seventy-eighth congress, second session, pursuant to H. Res. 230, a resolution authorizing the committee on labor to conduct an investigation on the extent and character of aid now given by the federal, state and local governments and private agencies to the physically handicapped and for other purposes.

Vocational Rehabilitation

The annual report, office of vocational rehabilitation, for the fiscal year, 1944, is now available at the cost of 10 cents, United States Government Printing Office.

Physical Therapist Recruitment

At the present time the authorization for physical therapists in the Army is 1,250 and this ceiling has almost been reached. By July 1 there will be 350 more physical therapists, who are now in training, ready for duty. All of these might not qualify. Under these circumstances there is an attempt being made to get the authorization increased because of the need for this additional personnel.

Qualified physical therapists are being commissioned direct from civilian life at the present time but because of the ceiling which has almost been reached and the number of physical therapists now in training an active publicity drive for them has not been conducted.

Recruitment of civilian for enlistment in the WAC for physical therapy training courses has been stopped.

Film Depicts Fitting Prostheses

British Information Services (30 Rockefeller Plaza, New York 20) now has available, for sale or loan, a two reel film revealing the part played by modern science in the making and fitting of artificial limbs, by means of which disabled persons are able to follow their old occupations or work at new trades which are taught them at government training centers. The film shows how men with the new artificial limbs are able to work at engineering, drafting, carpentry and other highly skilled occupations which formerly they could not have followed. Some of these men are shown in their hours of recreation playing tennis, golf, billiards or table tennis or at work in the garden.

Malpractice: Explosion of Bulb in Infra-Red Lamp

The patient suffered from arthritis and neuritis and at intervals for about four years submitted to infra-red treatments administered by the defendant chiropractor in his office. Dec. 6, 1940 she lay on a table unattended in a room with her back exposed to an infra-red deep therapy lamp, about 30 inches distant, having an unscreened 1,000 watt bulb. After she had been in this position for about fifteen minutes the bulb exploded without warning and hot glass fell on her back, causing severe burns. She and her husband instituted an action for malpractice against the chiropractor. At the conclusion of the evidence of the plaintiff at the trial the court granted a motion for nonsuit on the ground that the evidence had failed to prove negligence on the part of the chiropractor. On appeal, the district court of appeals, fourth district, California, affirmed the action of the trial court. *Crowe v. McBride*, 149 P. (2d) 69; J. A. M. A. 125:868 (July 22) 1944. The plaintiffs then appealed to the Supreme Court of California.

In considering the propriety of the nonsuit entered by the trial court, said the Supreme Court, we must accept the evidence that is most favorable to the plaintiffs and disregard that which is unfavorable. At the trial the plaintiff called as a witness the chiropractor, who stated he had made no inspection of the bulb that exploded and could make none other than turning it on to see if it was working; that he did not know what caused the bulb to explode; that he had never heard of one exploding before; that he had used the bulb in question for approximately two years before the accident; that he had a number of the same type which he used as frequently as ten times a day each; that some operated as long as five years before burning out; that there are about 200 lamps of this type in use in his locality; that the bulb in question was a standard one in general use, and that no manufacturer, so far as he knew, had ever theretofore recommended the screening of such lamps as a precautionary measure. The defendant's evidence, the Supreme Court emphasized, while indicating that the lamp to which the patient was exposed had no screen on it, was to the effect that the chiropractor did have screens on the other lamps in use in his office. The plaintiffs contended that the trial court could have reasonably concluded from the evidence that the chiropractor's failure to use a screen or other protective device constituted negligence. In answer to this the chiropractor argued that there was no evidence produced at the trial that he could have used a screen without interfering with the therapeutic efficiency of the lamp or that such a screen would have prevented injury to the patient. The court, however, concluded that an effective answer to the defendant's points was the fact that after the injury to the patient he used screens as a protective measure on all lamps in his office. From this, said the Supreme Court, the trial court could reasonably have inferred that a screen would not have interfered with the therapeutic efficiency of the lamp or that it would have afforded

at least some protection in event of damage to the bulb. Furthermore, the court thought it significant that in the brief filed by the defendant on appeal there was a concession that if a screen had been used the injuries to the patient might not have been so serious, "since only the smaller particles of glass would drop through the screen." The fact, remarked the court, that an available safety device would not entirely prevent an accident would not, of course, excuse the chiropractor from employing it to minimize injuries.

The chiropractor contended that since there was no evidence of any other similar explosions having occurred or that any manufacturer of similar lamps has recommended screens as a precautionary measure he had no reason to anticipate such a fortuity as occurred or to take precautions to avoid it. We cannot hold as a matter of law, said the Supreme Court, that the chiropractor had no duty to take such precautions. We believe that the chiropractor's use of the lamp without a screen presented a question to be determined by the trier of fact on the issue of negligence. Glass articles such as electric light bulbs are fragile and are frequently broken from many and varied causes. The 1,000 watt bulb used in this case was an exceptionally large one in comparison with an ordinary light bulb, and it was designed to generate heat. The likelihood of serious injury in the event of breaking, whatever the cause, was obvious and was much greater than could be expected from the breaking of an ordinary illuminating bulb. As has often been said, the care required must be in proportion to the danger to be avoided and the consequences that might reasonably be anticipated. The trial court might reasonably have concluded that the chiropractor should have anticipated that the bulb might break or be broken and that he did not take the precautions reasonably to be expected to avoid or minimize injury. The fact that the bulb broke or exploded in an unusual manner and that the exact cause of its doing so was unknown may be considered by the trier of fact, but it does not necessarily follow that the chiropractor is as a matter of law free from liability. As it said in Restatement, Torts, sec. 435:

If the actor's conduct is a substantial factor in bringing about harm to another, the fact that the actor neither foresaw nor should have foreseen the extent of the harm or the manner in which it occurred does not prevent him from being liable.

Furthermore, continued the court, accidents of this type are not entirely unknown, as at least two cases involving explosions of light bulbs have reached appellate courts. See *Hughes v. Atlantic City & S. R. Co.*, 85 N. J. Law 212, 89 A. 769, L. R. A. 1916A, 927; *Russell v. St. Louis & S. F. R. Co.*, Mo. App., 245 S. W. 590.

The Supreme Court accordingly held that the evidence with respect to negligence adduced by the plaintiffs at the trial was sufficient to present a question for the trier of fact and that the nonsuit should not have been granted. The judgment of nonsuit was accordingly reversed. — *Crowe v. McBride*, 153 P. (2d) 727 (Calif., 1944). J. A. M. A. 127:355 (Feb. 10) 1945.

West Virginia State Medical Association

The 1945 meeting of the West Virginia State Medical Association, scheduled for Clarksburg, May 14-15, has been officially canceled by order of the Council. This action was taken in view of the ODT ban on conventions where the attendance is expected to exceed 50 persons.

It is still hoped that an abbreviated meeting of the House of Delegates can be held sometime during the spring, but even this meeting depends upon the war situation at that time.

If you have made room reservations at a hotel in Clarksburg, I would suggest that you cancel the same. All hotels have been notified that the meeting will not be held, and notice has also been given our speakers and all technical and scientific exhibitors.

Army Training Reconditioning Instructors

The Army now has 680 officers and 1,486 enlisted men who are graduates of training courses in physical and educational reconditioning. More are constantly being trained, not only to take care of the increasing number of convalescents in Army hospitals, but to replace those instructors called to general duty.

Because able-bodied instructors in educational reconditioning are subject to reassignment at any time, every effort is being made to fill these posts from the Army roles of physically disabled. According to the Office of The Surgeon General, these handicapped instructors, many of whom have suffered amputations, are particularly inspiring to the convalescent soldiers they instruct.

Colonel Barton Conducts Red Cross Seminar

Lieutenant Colonel Walter E. Barton, MC, Assistant Director, Reconditioning Consultants Division, Office of The Surgeon General, is conducting a seminar on "Management of Special Disabilities from the Standpoint of Convalescent Reconditioning," with the American Red Cross In-Service Hospital Training Groups at American University, Washington, D. C. His seminar is attended by Red Cross field directors who will supervise Red Cross personnel working in hospitals.

Wartime Health and Education

Announcement is made of the publication of the interim report from the subcommittee on wartime health and education to the committee on education and labor, United States Senate, pursuant to S. Res. 74, a resolution authorizing an investigation of the educational and physical fitness of the civilian population as related to national defense, January, 1945. The Surgeon General of the United States Public Health Service urged development of a coordinated network of four basic types of medical center facilities, the small neighborhood or community "health cen-

ter," the "rural hospital," the "district hospital," and the large "base hospital." According to careful estimates made by the United States Public Health Service, facilities are needed for 100,000 new general hospital beds, 94,000 new nervous and mental hospital beds, and 44,000 tuberculosis beds. In addition, 66,000 general beds, 97,000 nervous and mental disease beds, and 16,000 tuberculosis beds are situated in hospitals that are obsolete and that should be replaced.

Another report considers the health needs of veterans, published February, 1945. In describing contemplated development of the medical care program, the Administrator of Veterans' Affairs has stated that ultimately 275,000 to 302,000 beds will be provided. There are now 101,275 beds available or authorized, including 15,685 for domiciliary care. The peak demand for hospitalization is expected by the Veterans' Administration to occur in 1975. Addition of 16,000 beds during the next 3 years is recommended by the Administration, bringing the total number of hospital beds, excluding domiciliary, to 101,540 by 1947. The Veterans' Administration contemplates the development during the next 20 years of a physical plant representing an investment of \$1,000,000,000 in addition to the present investment of \$213,000,000. The annual operating cost of hospitals will presumably approach \$300,000,000 annually, judging from present expenditures.

Annual Report of Infantile Paralysis Foundation

A total of \$1,828,859 was authorized by the National Foundation for Infantile Paralysis to be expended in grants and appropriations between Sept. 30, 1943 and May 31, 1944 for research, education and the training of physical therapists, according to a report released February 23. The report covers only an eight month period because of a change in the fiscal year, and future annual reports will cover operations from June 1 to May 31. The report contains the information that a special fund of two million dollars for epidemic aid and other emergencies has been established by the trustees, as of May 31, 1944, and that last summer's epidemic, the second worst outbreak of poliomyelitis in the history of the United States, drew on the newly created fund to the extent of \$739,860 for use to supplement chapter funds in local communities hard hit by the outbreak. This expenditure, between June 1 and Oct. 31, 1944, while outside the fiscal period covered by the annual report, is mentioned in it as demonstrating the necessity for the establishment of a special fund "for such unforeseen epidemics and other emergencies." During the eight months covered by the fiscal report the national headquarters received \$5,191,148 as its share of the 1944 March of Dimes appeal, an additional \$5,293,232 remaining with the National Foundation's county chapters. Receipts from other sources, including \$240,000 donated by the producer of the motion picture *Forever and a Day*, increased the total income of the foundation for the fiscal pe-

riod to \$5,452,593. The report discusses the extensive investigations and research carried on throughout the country in universities and other institutions through grants as well as certain projects conducted in the field during the 1943 outbreak. The report points out that in seeking improved methods of treatment of the disease it has been necessary to study other diseases and develop knowledge in many related fields.

New Convalescent Hospital Established

The War Department recently announced the establishment of a new convalescent hospital at Camp Upton, New York. The hospital will be under the command of Col. Edward A. Coates, M. C.

Artificial Tropical Climate Aids Rheumatic Fever

About 20 patients have been treated with good results in a special "tropical ward" at the University Hospital of Lund in South Sweden. The ward is known as the climatological laboratory and was established about three years ago at the suggestion of Dr. Gunnar O. Edstrom. It has double walls and quadruple windows, and all visitors must pass some time in a "sluice" so as not to carry cold and humid air into the ward. The temperature is constantly at 32 C. (89.6 F.) and the relative moisture is not permitted to rise above 50 per cent, while the average figure is 35 per cent. The climate thus produced corresponds to that of Puerto Rico, although it is slightly hotter and drier.

Appointment in Vocational Rehabilitation

Michael J. Shortley, Director, Office of Vocational Rehabilitation, Federal Security Agency, has announced the appointment of Dr. Jack Masur, Surgeon (R), U. S. Public Health Service,

as Chief Medical Officer to succeed Dr. Dean A. Clark, Senior Surgeon (R), USPHS. Dr. Clark has been on leave of absence during the past three months on a special project and will shortly be transferred to a new assignment in the Office of the Surgeon General, U. S. Public Health Service.

Dr. Masur, who has been serving as Assistant Chief Medical Officer since April 1, 1944, has previously been assigned as Hospital Administration Specialist to the Medical Division, U. S. Office of Civilian Defense. A native of Augusta, Georgia, and a graduate of New York University in 1928 and of Cornell University Medical College in 1932, Dr. Masur served his internship at Bellevue Hospital, New York City and was later Resident in Medicine at the Montefiore Hospital for Chronic Disease, New York City. Following a period of postgraduate medical study in Holland, he served as Assistant Director at the Montefiore Hospital until his appointment as Executive Director of the Lebanon Hospital, New York City, from 1941-1943. His previous activities and interests in the fields of hospital administration, tuberculosis, convalescent care, and chronic illness provide him with a background of wide experience in fields related to the physical restoration program phases of the expanded vocational rehabilitation program.

Dr. Victor H. Vogel, Surgeon, USPHS, whose appointment as Consultant in Psychiatry was previously announced, has been designated as Assistant Chief Medical Officer.

Clifton K. Himmelsbach, Surgeon, U. S. Public Health Service, and Frank F. Furstenberg, Surgeon, U. S. Public Health Service Reserve, have been appointed assistant regional representatives in the Office of Vocational Rehabilitation, Federal Security Agency. Dr. Himmelsbach will be assigned as assistant regional representative to the Kansas City, Mo., office and will provide assistance to the state vocational rehabilitation agencies in the organization and administration of the physical restoration phases of the vocational rehabilitation program.



BOOK REVIEWS

TREATMENT IN GENERAL MEDICINE. Edited by *Hobart A. Reimann, M.D.*, Magee Professor of Medicine, Jefferson Medical College, Philadelphia, with 34 contributors. Third Edition. Cloth. Four Volumes and Desk Index. Pp. 3154 with 320 illustrations. Price, \$40.00. Philadelphia: F. A. Davis Co., 1944.

This third edition is thoroughly revised to make it a complete work which goes far beyond the ordinary work on treatment. There are represented thirty-four authorities who take up therapeutic problems in every field of practice. In addition to a thorough discussion of general medicine, it also covers gynecology, obstetrics, pediatrics, neuropsychiatry, urology, proctology, dermatology, hematology, toxicology, geriatrics, minor surgery and physical therapy. In volume IV over three hundred pages are devoted to physical therapy. This section is contributed by Dr. John S. Coulter. In this section only those physical agents used by the general practitioner in his office or ordered by him for use in the home of the patient are considered. This means that many physical agents used in spas or hospital departments of physical medicine are omitted, such as hydrotherapy, hyperpyrexia, hydrogymnastics, occupational therapy and part of electrotherapy such as ion transfer.

These volumes are comprehensive in scope and authoritative in expression. By the elimination of unimportant and antiquated methods the authors have achieved clarity and simplicity. It is always up to date as a progress volume is issued as necessary with the contributors revising their subject to furnish the latest word on treatment. It is recommended as a well balanced work that admirably meets the needs of the busy practitioner.

A TEXTBOOK OF HISTOLOGY. FUNCTIONAL SIGNIFICANCE OF CELLS AND INTERCELLULAR SUBSTANCES. By *E. V. Cowdry*, Professor of Anatomy, The School of Medicine, Washington University and Director of Research, The Barnard Free Skin and Cancer Hospital, St. Louis, Mo. Third Edition. Cloth. Pp. 426 with 317 illustrations. Price, \$7.00. Philadelphia: Lea & Febiger, 1944.

This third edition has been thoroughly revised. It is a simpler textbook of histology, in which many of the details are brushed aside so that the fundamentals are revealed in their true proportions. This permits a closer focus of attention on the correlation of form and function by lightly passing over the minutiae because they are not

part of our dynamic concept of the body in action.

This book shows that the properties of each and every cell in the body are directly dependent on its heredity, the fluid about it and the other cells associated with it, and should only be investigated in this connection. The same is applied to the so-called elementary tissues, epithelial, connective and so on. These, likewise, do not exist for themselves and by themselves but function only insofar as they are integrated with the rest. Consequently the author builds up a conception of cells and elementary tissues in the many environments in which they normally exist. Organs and systems are stressed so as to relate structure and function in the whole body, itself the real physiologic unit.

The method of presentation is unchanged. As before it centers about the blood vascular system as the principal integrator. Structure and function, being really indivisible are described together in their natural fluid environments. When so connected a dynamic picture of the integrated whole gradually takes shape. The author calls attention that as far back as 1859 to 1860 the French physiologist, Claude Bernard was teaching his medical students about the importance of the internal fluid environment.

The author concludes this book with some statements that we should all remember: "The ways of Nature are not simple. Nothing is more conducive to loss of face than to ignore the dictum that 'Nature moves in mysterious ways her wonders to perform.' The deeper we dig in any problem, however simple it first may appear, the more complex it gets. Complete understanding of any vital property is quite beyond us. Constant change in adaptation to myriad influences everywhere is manifest. A single part of the whole is never structurally the same as two intervals in time and the body is so much a unit that the statement is probably justified that if we knew all about any part our knowledge of the whole would be complete. Wise physicians acquire increasing respect for the efficiency of natural adjustments and learn to help Nature herself interfering radically only when she is obviously up against it. They know that the noblest study of man is man and that had our forebears more closely examined the workings of Nature in man they would not have taken so long to invent the principles of the hinge and the lever to say nothing of how electricity is harnessed in muscular contraction first observed by Galvani. And the end is assuredly not yet."

This book is highly recommended as a textbook of histology giving the functional significance of cells and intercellular substances.

ESSAYS IN THE HISTORY OF MEDICINE. Presented to Professor Arturo Castiglioni on the occasion of his seventieth birthday, April 10, 1944. Supplements to the Bulletin of the History of Medicine. Editor, *Henry E. Sigerist*; Associate Editor, *Genevieve Miller*. No. 3. Price, \$3.50. Pp. 358. Baltimore: The Johns Hopkins Press, 1944.

This is a stimulating collection of papers of international scope, assembled to honor an outstanding medical historian. A dedication written by Henry E. Sigerist depicts the highlights of the life of Doctor Castiglioni; his early work as a liberal writer in Italy; his subsequent exile to the United States to escape fascist tyranny and his remarkable adjustment to the life in a new country, resulting in an invigorated creative ability. It also points out that after the catastrophe of the Italian people at least the dawn of a happier, free and democratic era has come. The list of contributors to the volume includes a galaxy of clinicians and medical historians, five papers in Spanish, two each in French and German, one in Italian and thirteen in English. It is possible to enumerate only the most interesting ones here.

"Paul Bert's Triumph," by Erwin H. Ackerknecht comments on a great French classic on aviation medicine written by Bert and published first 65 years ago and now translated into English. That a scientific book should be translated and re-edited after 65 years, not for historical but for practical reasons, is a still greater triumph for the author himself, a triumph no other 19th century physiologist has achieved so far or is likely to achieve.

"Polydore Vergil, His Chapters on the History of Physick and His Anglica Historia," by J. F. Fulton, gives many excerpts and full page reproductions from the works of one of the great humanist scholars of the Renaissance. Born and educated in Italy, he made his way across the Alps to England and became a naturalized Englishman. Polydore Vergil's history of England stands in relation to historiography in much the same position as the *Fabrica* of Vesalius stands to anatomy. Vergil's historical method was far in advance of anything produced prior to his time in England.

"Angina Inflammatoria (Diphtheria?) as Described in David Orme's Edinburgh Dissertation (1749) and Benjamin Morris Leyden Dissertation (1750)," by Edward B. Krumbhaar and W. B. McDaniel, 2d gives the title pages and full excerpts of two dissertations from the two leading medical schools of Europe. The authors point out that the subtle emphasis and the immediate effect of the teaching, which determine the after influence it is to have, can best be gauged by the dissertation, which, in principle at least, publishes the intellectual professions of the school and the intellectual capacity of the student; they consider it regrettable, therefore, that the medical dissertations have not more often been resorted to in studies of the development of organized medical teaching. The two essays offer interesting comparative material for a study of the relation

between academic teaching and the general status of medicine in the mid-18th century.

"Los Hospitales de America Durante la Epoca Colonial," by Carlos Martínez Durán, is a Spanish essay on the hospitals founded by the early "conquistadores" and missionaries in Central and South America during the 16th, 17th and 18th centuries; the first hospital on record being one at Santo Domingo in 1502; there is a chronologic list of 37 hospitals founded in Brazil, Chile, Guatemala, Havana, Mexico and other places, the last being the women's hospital in Santiago de Chile in 1792; there are also some photographs of exteriors and lay-outs. This is an interesting demonstration of the social and scientific contribution of the Spanish settlers of America.

"Medical Matters in Marco Polo's Description of the World," by Leonardo Olschki, is a fascinating demonstration of how closely geographic discoveries and medical experience are correlated. It also contains an account of the exploration into medieval Asiatic medicine by Franciscan Friar William of Rubruck, preceding Marco Polo.

"Der Zahnbrecher des Hans Sachs," by Curt Proskauer, contains a full reproduction as well as a commentary of an illustrated comic poem written in old German by Hans Sachs, "Shoemaker and Poet" of 16th Century fame. The "zahnbrecher" or "tooth breaker" was a medical quack flourishing at the time of the Reformation and the depiction of his antics, the general behavior of the populace, all in comic and at times drastic rhyme, offers a unique medico-social document of the period of the Reformation in Germany.

"Beccaria" (1738-94) by George Sarton deals chiefly with an immortal volume "*Dei delitti e delle pene*," written by a young man of twenty-six, by birth an Italian, living under the despotism of the then existing Austrian regime of Italy. "Essays on crimes and punishments" was a proposal to establish criminal justice on a rational basis, reducing penal laws and procedure to some kind of uniformity, eliminating as much as possible every cause of arbitrariness. Beccaria's work awakened the conscience of men as few books ever did. He explained the need of separating the legislative from the judicial function. He discussed the origins of punishment, the right to punish and its restrictions. Punishment should not be in the nature of a vengeance, it should never imply torture or ill faith. The immense success of "*Dei delitti e delle pene*" was the best proof of the book's timeliness. Six Italian editions appeared within 18 months, and it was soon translated into French, English, German, Dutch, Spanish, Greek and later into Russian, Hungarian and Bohemian. The title pages of most of these translations are shown in Sarton's essay. During the nineteenth century Beccaria's views were so completely realized that at the end of it they looked like platitudes and it required some effort of imagination to understand their boldness. However, the perversion of justice obtaining today in a great part of continental Europe is so profound that when the European nations are liberated they will again need such a primer as

Beccaria's little treatise in order to regain their education in freedom and dignity.

As shown by the essays reported on, the "Festschrift" honoring Professor Castiglioni adds another volume of absorbing interest to the "Supplements to the Bulletin of the History of Medicine" so ably edited by Doctor Sigerist and his staff. The study of these volumes will add to the cultural and professional knowledge of every physician.

SOLDIER TO CIVILIAN. PROBLEMS OF READJUSTMENT. By *George K. Pratt, M.D.*, Psychiatric Examiner, U. S. Armed Forces, Induction Center, New Haven, Connecticut; formerly Assistant Clinical Professor of Psychiatry, School of Medicine, Yale University. Foreword by *George S. Stevenson, M.D.*, Medical Director, The National Committee for Mental Hygiene. Cloth. Pp. 233. Price, \$2.50. New York: McGraw-Hill Book Co., Inc., 1944.

What is done wisely for the veteran is a task for our whole public. Nothing could do more to strengthen democracy than universal participation in meeting this kind of reality with the same energy and time as we applied to air-raid precautions. But the task is to no small degree technical and, if sound processes are to be effected, processes that will result in success of this broad effort rather than the disillusionment that follows superficial dabbling, a professional personnel well selected and trained is essential. It is a task as well for a variety of professions and trades. The needs of the veteran will most frequently be nothing more than a friendly, loving, receptive public ready to give the veteran the opportunity to resume civilian life. In many instances there will be needs for more specialized help, medical for the disabled, occupational guidance for the young and handicapped, social services for the shattered family, educational service for those requiring retraining or continuance of plans and financial help for a variety of circumstances.

In simple, understandable language the author gives sensible advice and concrete suggestions on how to handle many of the situations that will be met with in regard to returning soldiers. Family life, marital relations, community position and occupational adjustment of the service man are frankly and fully discussed. Particular attention is directed to the man who returns with a physical or psychiatric handicap.

The author is an outstanding American Psy-

chiatrist who has had a wide and varied experience. This book is written for and highly recommended to the relative, friend, or employer who sincerely wishes to be helpful to the ex-serviceman in the period of transition from military to civilian life.

THE PSYCHIATRIC NOVELS OF OLIVER WENDELL HOLMES. Abridgment, Introduction and Annotations by *Clarence P. Oberndorf, M.D.*, Clinical Professor of Psychiatry, Columbia University. Price, \$3.00. Pp. 268. New York: Columbia University Press, 1944.

The urbane and witty Doctor Holmes was a distinguished physician and a well-loved poet and essayist. But his three novels have heretofore been dismissed as unimportant. In this new presentation, they have been abridged and extensively annotated by Dr. C. P. Oberndorf; and they reveal in Holmes a psychologic originality and understanding which anticipated many of Freud's formulations. These three "medicated" novels are "Elsie Venner: A Story of Schizophrenia," "The Guardian Angel: Hysteria in a Young Girl," and "A Mortal Antipathy: A Young Man's Morbid Fear (Gynophobia)." The Study of situations involving medical and psychiatric problems in novels is not uncommon. Some are presented in the form of confessions, as the famous self-revelation of Jean Jacques Rousseau, or in a letter to a psychiatrist, as in Marcel Prevost's *His Mistress and I*, or in deliberate psychoanalytic studies, as the recent phantasy-drama *The Lady in the Dark*. In his illuminating notes Doctor Oberndorf draws on his clinical experience to supplement and interpret Holmes' descriptions of psychopathic conditions. The book is a novel idea in psychiatric presentation. It should appeal to the general public and to medical students, physicians, ministers, social workers and others particularly interested in the social aspect of mental disease.

THE UNFIT MADE FIT. By *Harold Balme*. Paper. Pp. 33, illustrated. London: Longmans Green & Co., 1943.

This pamphlet is distributed by the British Information Services, 30 Rockefeller Plaza, New York City. It shows in story and excellent pictures some of the things, especially in exercises and occupational therapy, in which Britain has contributed notably to modern progress in rehabilitation.

PHYSICAL MEDICINE ABSTRACTS

Reconditioning in Chest Surgery. John B. Grow, Omer M. Raines, and Ora L. Huddleston.
J. A. M. A. 126:1060 (Dec. 23) 1944.

The problems to be overcome in the physical reconditioning of the patient convalescing from a surgical disease of the chest are (1) a lowered vital capacity, (2) a decrease in stamina and strength incident to a protracted debilitating illness, (3) postural defects and (4) the loss of power of large muscle groups incident to extensive muscle cutting incisions. The other phases of reconditioning, educational reconditioning, occupational therapy and recreational and diversional activities are fully as important in this type of patient as in other groups, owing to the usual history of long standing disease with its attendant depression of morale.

The rehabilitation of the tuberculous patient is a long term program, which owing to the nature of the disease, must be carried out under the supervision of a phthisiotherapist.

From the standpoint of reconditioning, the authors have found it convenient to group the cases of empyema and lung abscess not associated with bronchiectasis together.

As the patient's condition permits, breathing exercises, calisthenics and outdoor drills and marches are engaged in. Vigorous physical activity has been found to be of definite benefit in hastening the obliteration of empyema and lung abscess cavities. The usual experience is that by the time the empyema or lung abscess cavity has disappeared the patient has been restored to his normal weight, stamina and strength.

The reconditioning of patients following pulmonary resection may be divided roughly into three stages: (1) the immediate convalescent care, (2) the physical therapy period, comprising the period from the seventh postoperative day to the twenty-first postoperative day, and (3) the period from the twenty-first postoperative day to the time of his discharge from the hospital, when he is a patient in the reconditioning service.

The seventh to the twenty-first postoperative days fall into the physical therapy period. During this time breathing exercises and shoulder exercises are started while the patient is still confined to the ward. The shoulder exercises consist of moving the arm through a complete range of motion supplemented by repeated passive exercises. Later these are changed to active assistive exercises and active exercises of the shoulder girdle. The shoulder exercises are unilateral and confined to the operative side. Breathing exercises are bilateral and symmetrical and involve the contractions of the accessory respiratory muscles as well as the regular inspiratory and expiratory muscles during strong, forced breathing.

After the third postoperative week the patient's convalescence is sufficiently advanced that he may be transferred to the Reconditioning Service. The exercises concentrate in increasing the vital capacity and restoring the strength of the shoulder girdle. The men are trained in the use of and encouraged to engage in activities with indian clubs, rowing machines, pulley weights, dumb-bell exercises, straddle pull ups, push ups, chin ups and resistive exercises. For patients who have no draining sinuses swimming has been found to be important, from the standpoint both of recreation and of physical conditioning.

Novocaine Iontophoresis for Painful Limitation of Motion. William Benham Snow, and Hans Kraus.

Mil. Surgeon 95:361 (Nov.) 1944.

The common indication for novocaine iontophoresis combined with active exercise is limitation of motion by pain and muscular spasm. Such conditions are sprains of all joints; acute muscular spasm such as is found in bursitis, lumbago, strained muscles, certain cases of low back pain and the like; chronic muscular spasm found in such conditions as chronic low back pain, sciatica, chronic spasm of the shoulder. Ion transfer of novocaine and exercises may be used as a diagnostic therapeutic test while major surgical procedures are being considered. When so used, prompt reversal of symptoms may frequently be obtained.

The technic of the treatment is as follows: A solution of 1 per cent novocaine hydrochloride and 1/20,000 adrenalin in 80 per cent alcohol is prepared. The area of treatment is determined. The area must always be considerably larger than the area of the distribution of the pain. A gauze pad of two to four layers is soaked in the solution and placed over the area to be treated. A crash towel folded once or twice, soaked in saline, is spread over the gauze and a flexible metal electrode is placed over it. The metal contact must be smaller than the area of the towel and care must be exercised that no metal touches the patient's skin. The positive pole of a source of galvanic current is attached to the metal electrode. The combination electrode is carefully fixed in place with sandbags or bandages. A neutral electrode of approximately the same size, moistened with weak saline is connected with the negative pole. The current is slowly applied and increased to 20 milliamperes and permitted to flow for 20 minutes. The current is then gently reduced to zero and the electrodes are removed. The area treated usually shows blanching. Surface analgesia is present and remains for approximately three to four hours over the area treated.

Role of Industrial Medicine in the Rehabilitation of Veterans. J. F. Johnson, and H. V. Hoffman.

J. A. M. A. 126:1077 (Dec. 23) 1944.

It is obvious that the primary responsibility of manufacturing industry is to the former employee with a service connected disability.

There is not much difference between the returned veterans as a whole and the civilian group as a whole.

It should be recognized that not all veterans can safely be given a job in the field in which they wish to work. For instance, some with hypertensive or valvular heart disease should not be started on a training program intended to fit them for a laboring job.

The authors give a few case histories of individuals who, in their opinion, are veterans only because the preinduction military service examination did not weed them out. These cases are mentioned, not because they are typical but because it is just such a case as this that might cause the more deserving veteran some inconvenience (note the need of finding the "real" cause of discharge versus the "alleged" cause):

Eighty-five per cent of veterans now returning are satisfactory employees.

Some veterans need advice in reconstructing their own life. The need for such reconstruction frequently existed before their induction into service.

Manufacturing industry will probably employ one out of every seven veterans returning, according to our past experience.

Bicipital Tenosynovitis. Robert K. Lippmann.

New York State J. Med. 44:90 (Oct. 15) 1944.

The typical case of periarthritis, or frozen shoulder, commences with a mild ache in the shoulder or arm, which grows inexorably worse and is accompanied by progressive stiffness. The pain grows in intensity, becoming almost insufferable, and the stiffness slowly increases to the point of almost complete scapulohumeral fixation. After months of growing distress (often increased by scalene spasm and pain down the arm), the pain starts to abate and shoulder motion begins to improve. Undulant progress continues until the shoulder is again clinically normal. During the period when the disease is progressing, the pain dominates the picture. In the period of improvement, stiffness is the most prominent complaint.

The typical clinical aspects of periarthritis, or frozen shoulder, are reviewed, with emphasis on the fact that, though its duration is unpredictable, the condition almost invariably terminates spontaneously in complete recovery.

Surgical investigation on more than 30 cases of frozen shoulder has revealed that at least in most instances the subdeltoid bursa and underlying musculotendinous cuff are not involved and that, instead, tenosynovitis of the long biceps tendon and sheath is consistently encountered.

Adhesive tenosynovitis extends from the sheath

into the outer quadrant of the shoulder joint proper, but the entire inflammatory process subsides spontaneously when the tendon becomes firmly attached to the bicipital groove and its motion is so obliterated.

The pathologic sequence underlying periarthritis provides a guide for the administration of conservative therapy and suggests a simple surgical approach when more rapid cure is desired.

The Treatment of Stricture of the Urethra With the High Frequency Cutting Current. George R. Livermore.

J. Urol. 52:462 (Nov.) 1944.

Some years ago the author advocated a new treatment for stricture of the urethra in the application of the high frequency cutting current to the strictured area. He devised a sound shaped electrode, with a copper strip on its convex surface, through which the current was applied to the stricture. The method was not considered a cure-all but it was believed that it did promote absorption of the scar tissue, made the stricture dilate more easily and was not unduly painful. Strictures so treated, showed less tendency to re-contract than those in which only sounds and dilators were used.

A specially constructed instrument called the galva-dilator was used to deliver a galvanic current to the strictured area through an electrode, to the distal end of which bulbs of varying size could be attached. The results of the author with the use of this instrument were not as satisfactory as those obtained with the high frequency cutting current. As the bulbs are metal, they deliver the current to the entire stricture. The author decided to use the electrode and bulbs of the galva-dilator to apply the high frequency cutting current to the stricture. He claims his results have not been as satisfactory as those obtained with the use of a sound electrode.

Changes of Weight and Neuromuscular Transmission in Muscles of Immobilized Joints. P. Thomsen and J. V. Luco.

J. Neurophysiol. 7:251 (July) 1944.

Thomsen, Altamirano and Luco demonstrated that synaptic changes occur in a muscle whose tendon has been cut three to fifteen days previously, and suggested the possibility that section of the tendon would result in an exaggeration of the postural reflexes, since some of the muscles pulling on the joint now lack antagonists. More recently, it has been found that these synaptic changes disappear when the tendon spontaneously regrows, reestablishing the equilibrium at the joint despite the persistence of muscular atrophy produced by tenotomy.

In order to determine the effect of position of the limb and of stretch of the muscle on neuromuscular transmission, studies were made in animals in which the tibio-tarsal joint had been immobilized by a plaster cast in one of three posi-

tions, namely, hyperflexion, hyperextension and intermediate. The responses of the soleus muscle to different frequencies of stimulation were recorded and the sensitivity of this muscle and of the tibialis anticus to curare was determined. In each experiment the homologous muscle of the opposite leg was used as a control. Hyperflexion produced maximal stretch of the soleus and maximal shortening of the tibialis, whereas hyperextension produced the opposite. In addition to the neuromuscular transmission, the weight of the two muscles, thus exposed to high or low tension, was studied.

The influence of fixation of the tibio-tarsal joint on the neuromuscular synapse and the weight of the soleus and tibialis anticus muscles was studied in cats anesthetized with nembutal. The joint was fixed in hyperflexion, hyperextension and intermediate between these two.

After immobilization in these 3 positions, these muscles show the same changes in neuromuscular transmission as are found in tenotomized muscles. At high frequencies of stimulation there was a greater development of the third stage of neuromuscular fatigue in relation to the first stage than occurred in the control muscles.

The immobilized muscles resemble tenotomized muscles also in being less sensitive to curare.

Fixation in hyperflexion for up to fourteen days causes an increase in the weight of the soleus and a decrease in the weight of the tibialis.

Conversely, fixation in hyperextension causes a decrease in the weight of the soleus and an increase in the weight of the tibialis.

In the discussion the hypothesis is presented that in immobilization, as in tenotomy, the abnormal tension to which the muscle is exposed causes the neuromuscular changes by a reflex mechanism.

Early Ambulation Following Abdominal Section.

J. A. M. A. 126:594 (Oct. 28) 1944.

Nelson reports observations on 426 personally conducted cases. As soon as the patient has fully recovered from the effects of anesthesia, the bed is sharply tilted, so that the head is elevated. After this position has been maintained for a time the bed is leveled and the patient assumes a sitting position on the side of the bed, with the feet resting on a chair. In this position he breathes deeply and coughs frequently. He then lies down, and the head of the bed is again sharply elevated. After a second period of rest he is assisted to stand and is conducted to the bathroom, where the bladder is practically always emptied without difficulty. If his condition is good he sits up in a chair for a time before returning to bed. Those who are oversensitive to the pain of the first rising or who are unduly apprehensive are made to practice sitting at the edge of the bed, with intervals of rest after each attempt, until they are strong enough and willing to walk to the bathroom. The majority of patients walked on the day of operation or within

the first twenty-four hours. The incidence of immediate and delayed complications in this series was minimal. Of the three partial disruptions of a wound two occurred in patients whose wounds had been closed with catgut and for whom early ambulation had not been authorized. The single fatality in the series was due to cerebral thrombosis. Good results depend on the strict observance of contraindications as well as of indications. Contraindications to early ambulation are: 1. Failure to observe the prerequisites of optimum healing of wound. 2. Conditions such as shock, peritonitis, active hemorrhage, cardiac failure, pneumonitis and impending or actual thyroid crisis. 3. Potential or actual complications including gross contamination, infection, hemorrhage and dehiscence. 4. Pregnancy in which abortion is feared. 5. Extreme debility, for which ambulation is deferred until there is some restoration of strength and muscle tone, as a result of sitting up. 6. Second stage of a thoracolumbar sympathectomy, after which the patient, because of sudden alterations in the vascular system, cannot immediately tolerate the upright position. 7. Lack of adequate and intelligent nursing supervision. The advantages of early ambulation include the lowered incidence of postoperative complications, particularly pulmonary and vascular complications; the lower incidence of nausea, vomiting and abdominal distention; the earlier return of normal function of the bladder and the bowel; the maintenance of normal muscle tone; the psychologic effect on the patient's morale and mental status; the acceleration of convalescence and the earlier return of working ability, and the economic savings to the patient and the hospital.

Ultrashort Wave Treatment of Breast Abscess. Nellie I. Lanckenau.

Brit. J. Phys. Med. 7:179 (Nov.-Dec.) 1944.

In puerperal cases, prophylaxis during the antenatal period should play an important part and general ultraviolet light should find a place in the program, together with instructions on hygiene of the breasts.

Ultrashort wave therapy assists the localization of an abscess of the breast. After the latter has been opened, short wave therapy hastens healing and lessens induration.

A six-meter wave length machine and Schliephake electrodes should be used. For some cases it is better to use one glass electrode and a medium sized or large sized pad electrode.

In a series of 45 cases of abscess of the breast, either due to trauma or to chronic mastitis or occurring in the puerperium, the number of treatments required ranged from 1 to 11. There is reason to presume that patients treated by ultrashort wave therapy, in conjunction with surgical measures or with the application of penicillin, recover more quickly; they find relief from pain after the first treatment.

Simplification of the Method of Electrical Examination and Therapy of Nerves and Muscles.
Herman De Jong.

North Carolina M. J. 5:92 (March) 1944.

Difficulties, both of a theoretical and of a practical nature, which have arisen in the past have made electrical examination and therapy of nerves and muscles less popular than it should be. At the present time the requirements of military surgery demand a thorough knowledge of the degree and kind of lesions of peripheral nerves, since early suturing of severed peripheral nerves by the neurosurgeon has such an extremely favorable prognosis.

A galvanic apparatus is capable of serving simplified diagnostic purposes almost completely. It is also sufficient for therapeutic purposes. For example, after suturing of a nerve, daily galvanic stimulation will counteract muscular atrophy during the period before conduction is re-established. The muscle becomes inexcitable by faradic current in severe cases (total degeneration). Faradic stimulation could not counteract atrophy in such cases, in contrast to galvanic therapy. A simplified stimulator without the meter would be easily operable by the patient himself if the doctor pointed out to him the location of the motor points where he should apply the "active" electrode.

Synchronization of Spontaneous Activity in Denervated Human Muscle. **Abner M. Harvey,**
and Stephen W. Kuffler.

Arch. Neurol. & Psychiat. 52:497 (Dec.) 1944.

If mammalian muscle is deprived of its nerve supply, no spontaneous activity can be observed for several days. After that period spontaneous contraction of individual muscle fibers sets in, and may persist for a year or longer unless nerve regeneration occurs or the contractile muscle tissue disappears. This activity is not visible through the skin. Visible movements of groups of muscle fibers are always associated with the discharge of at least one motor nerve impulse. To the knowledge of the authors, there has not been described in the literature a case of spontaneous synchronized activity of muscle fibers in a completely denervated muscle. Such a case, in which absence of innervation could be ascertained by various methods, has been under observation for several months at an army general hospital.

In an investigation of the spontaneous synchronized activity of groups of muscle fibers in muscles of the hypothenar eminence of a patient in whom the motor fibers of the ulnar nerve had been completely interrupted for four months, the following observations were made: Electromyographic recordings showed muscle groups discharging at a frequency of 8 to 10 per second. The discharges tended to appear in constant rhythmic groups. The number of spontaneous movements could be greatly increased by stretching of the muscles. Complete absence of innervation of the active muscles was demonstrated by

various methods. The origin and the synchronization of the activity may have occurred at the region of end plates in the denervated muscles.

Primary Tuberculosis. Effect of Unrestricted Activity on Prognosis. **Milton I. Levine.**

Am. J. Dis. Child. 68:389 (Dec.) 1944.

Within the past few years preventorium and treatment in the open air for children who react positively to the tuberculin test have for the most part been discontinued, for it is now generally accepted that a positive reaction to tuberculin is by itself no indication for added care except that occasional roentgenograms should be made. It has also been recognized that a child with only a positive reaction to tuberculin is no menace to other children.

On the other hand, the treatment of a patient with tuberculous infiltration of the parenchyma of the lungs during the active phase of the primary complex as evidenced by roentgenograms is still subject to dispute. Many physicians continue to advise rest in bed during the infiltrative phase of the primary complex in the hope that recovery will be hastened and complications avoided. Other physicians feel that the course of a primary tuberculous infection and its subsequent outcome are not modified by treatment.

In the opinion of the author, rest in bed during a primary infection with tuberculosis should be limited only to the period of elevation of temperature, as would be advised in the treatment of any febrile condition during childhood.

Intensive Arsenotherapy of Early Syphilis.
Arthur G. Schoch.

Texas State J. Med. 40:225 (Aug.) 1944.

Early syphilis, namely, primary and secondary syphilis, can now be cured in a period of from one to sixty days.

The one-day treatment for early syphilis consists of fever therapy in a fever machine for eight hours, during which time the patient receives, intravenously, three to four hundred milligrams of phenarsine hydrochloride (mapharsen). This method of treatment was developed by Simpson, Kendell and Rose. It is still purely in the experimental stage and is being evaluated by the Chicago Intensive Treatment Center, under the direction of Kendell and Karkosch.

The standard method of treatment for early syphilis required a period of eighteen months of weekly injections of arsenical, given in courses, combined with bismuth, given in courses.

One can see from the above résumé that the standard eighteen months' system of treatment has been telescoped downward into a maximum period of six months (Army) to a minimum of ten days for ambulatory patients.

Treatment of early syphilis in hospital patients, furthermore, has been intensified and telescoped into a ten-day maximum period down to a one-day minimum period.

One can draw several general conclusions or deductions at present as follows: The shorter the duration of treatment the greater the risk, from the standpoint of serious and fatal treatment reactions. The therapeutic results of all of these rapid methods of treatment are approximately the same. The addition of fever enhances the therapeutic activity, that is, the percentage of cures, but increases the risk to the patient. The addition of bismuth to any of the above mentioned schedules enhances the therapeutic activity percentage of cures without increasing the risk to the patient. From a practical standpoint hospitalization is undesirable and any rapid method of cure necessitating hospitalization, generally speaking, is inferior to that which can be applied to ambulatory patients.

Treatment reactions of the major type are almost exclusively hemorrhagic encephalitis which, generally speaking, occurs in one patient out of every one hundred. Death results from this complication in one patient out of every three hundred (five or ten day treatment). Women are definitely more susceptible to this complication than men are.

When treatment consists of intravenous arsenical therapy in the form of arsenoxide (mapharsen) in combination with fever, a second serious complication makes its appearance in the form of acute nephrosis.

Refrigeration for the Preservation of Traumatized Tissues. Lyman Weeks Crossman.

Canad. Hospital 21:52 (Aug.) 1944.

Most of the experience of the author has been at the New York City Hospital with patients who were old, debilitated, undernourished, usually unemployed, suffering not from one disease but from many pathologic states and with no incentive to live. After varying periods of neglect they would be admitted with gangrene, diabetic and/or arteriosclerotic, perhaps with superimposed infection of the feet. Previously all other types of anesthesia had been tried and the mortality was high, most of the patients died of shock, or infection, or embolism. Now, most of these old people live and walk out of the hospital because with refrigeration anesthesia there can be no shock, or infection, or embolism.

The pathologist at the New York City Hospital, has examined every extremity removed and found no microscopic change due to the prolonged low temperature or the pressure of the tourniquet. The tourniquet is placed as much as 10 inches proximal to the skin incision. Because the specimen removed would not show changes at the tourniquet line, tourniquet is placed at the upper one-third of the leg, refrigerated for twenty-four hours before the thigh is prepared for amputation. The original tourniquet is not removed until the pathologist is ready to take biop-

sies. Sections are made proximal to the tourniquet, at the site of ligation and distal. Microscopic studies showed no tissue changes due to the prolonged refrigeration and tourniquet constriction.

The Successful Treatment of Diabetes. Alexander Marble.

Texas State J. Med. 40:233 (Aug.) 1944.

The constant improvement in the treatment of diabetes is attested by the increasing length of life, the earlier detection and lessening of specific complications and the growing capacity of diabetic persons to engage in useful occupations. These are matters of great importance because at the present time well-considered estimates place the number of diabetics in the United States at about 800,000. This means that there is 1 diabetic in each group of 165 or 170 members of the population at large with a much greater incidence in certain selected groups weighted as to one or more of the following: heredity (diabetes in family), age (over 40), sex (female), body build (obese), residence (urban) and racial stock (Jewish).

No account of the successful treatment of diabetes would be complete without a word as to the value of physical activity. In patients in whom, by nature or by injection, a satisfactory amount of insulin is present in the body, exercise augments the blood-sugar-lowering effect of the insulin in addition to producing the non-specific beneficial effects such as the development of muscles. In addition to promoting wellbeing, moderate exercise regularly taken usually permits or even necessitates a lowering of the total amount of insulin given daily.

A Case of Light Sensitization. David Erskine.

Brit. J. Dermat. 56:198 (Sept.-Oct.) 1944.

A case of light sensitization, in an electric welder, is of interest on account of the difficulty of treatment, and because the sensitization appears to be of unusual type. The condition, which was probably caused by his work, cannot legally be considered an occupational dermatitis, which is defined as dermatitis caused by dusts or liquids.

Investigation of this case suggests that the patient is sensitive to the ultraviolet wave band, and thereby differs from the hitherto recognized light sensitization of adult type, cases of which are sensitive to rays of a wider band, including at least a proportion of longer wavelength. The adult type of sensitization is frequently associated with evidence of hepatic insufficiency and subjects are not protected by quinine or tannic acid, which further tends to differentiate this case from the more common type. Finally, injections of concentrated vitamin A esters failed to benefit the patient.